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Storage Battery Traction. WE give elsewhere in our columns a report on the Dubuque storage battery road, the information being supplied by the equipping company. As is well known, there has been considerable wrangling in the case, and its merits are not easy to determine. From what information can be obtained it would appear that the care given to the cells was by no means sufficient to obtain from them the best results, although the renewal expenses are not much in excess of those found elsewhere. The storage battery requires for its use very careful handling, and should be intrusted only to picked men, while it is hard to bestow too much pains on the operation of the station equipment. Results obtained abroad in Birmingham indicate that where sufficient care is given the financial results are reasonably good, and experience there disclosed a considerably smaller renewal account than was found at Dubuque. Replacements and repairs amounting to $800 and $1,000 per car per year make a pretty severe strain on the gross receipts of a small street car line, and to any company that proposes to operate by means of storage batteries, we can only say, bear in mind the experience of your predecessors, and exercise as careful a supervision as possible over the use of the batteries, remembering that while they will give good service when in first class condition damage goes from bad to worse with great rapidity.

Brooklyn Will Be Up with the Times. THE trolley wrangle in Brooklyn, which we have had occasion to mention several times recently, is apparently coming to an end. Its probable termination will give great satisfaction to the friends of electric traction all over the country. In the first place the Brooklyn & Coney Island Railway Company has by a decision of the Street Railroad Commissioners been allowed to change its motive power to electricity under reasonable requirements. And more than this the Board of Aldermen has passed again a series of resolutions substantially the same as those which Mayor Boody vetoed, and it now appears probable that there will be no second veto to interfere with the progress of the Brooklyn surface roads. His Honor, the Mayor, is wisely seeking information from cities where the trolley system is already in use, and it will not be surprising if his conversion should be as rapid as that of Mayor Grant when that gentleman had an opportunity in Boston to see how electric traction works in a densely populated city. Everything is auspicious now for a general change of motive power at an early date. The Railroad Commissioners look upon the matter reasonably, and, as we suggested at the time of the late veto, the Board of Aldermen did not lose its nerve, but went ahead to press the matter to an issue. All this is infinitely satisfactory, for it would indeed be a pity to restrain the street railway companies from making a change that will be so productive of good to the public. It would be interesting some time to analyze the opposition to the trolley system; it would nearly always be found that the bulk of the people, the everyday population that does the work of a great city, would be a unit in favor of anything that could make easier going to and from their respective homes. The people who object to electric cars are those who do not ride in them, and the sooner this fact is realized, and the great active public comes to understand that an attack is being made upon it instead of upon the trolley system, the easier will such improvements be for the future.

Electric Block Signals. ON another page we devote some space to an account of the electric block signaling systems employed on the New York Central Railroad. The subject is a most interesting one, for it bears directly upon the safety of the traveling public. The officials of the New York Central are now thoroughly aroused to the importance of the situation, and are displaying very commendable activity in atoning for their sins of omission. Especially interesting to our readers should be the account of the first automatic block signal system to use the "normal danger" method of operation, for it is an electrical novelty based on the best railroad practice in vogue abroad. Another interesting point is involved in the conditions existing in the tunnel that leads to the Forty-second street station. At present the Sykes block signal system is in use through its length, supplemented by special signals that seem to leave no loophole for accident But the unfortunate thing about the tunnel is that the immense amount of traffic through it involves the use of so large a number of locomotives that a smoke cloud constantly fills the tunnel in spite of every effort at ventilation. The engineers learn by experience to see the conditions of the signals under circumstances when mankind in general could see nothing whatever except a confused glare. Of the remedies proposed none seem sufficiently radical to meet the exigencies of the situation. Electric lighting could be regarded only as a palliative measure, for one has to deal, not with darkness, but with dense banks of smoke that diffuse the light and defy any effort at penetration. Ventilation of a sufficiently thorough character is out of the question. The only improvements that would seem feasible are the operation of signals right under the engineer's nose in the cab or the replacement of locomotives that run through the tunnel by motors. This would avoid the difficulty, but might be somewhat inconvenient in practice. It is to be hoped that the present precautions taken will prove sufficient to obviate any necessity for further changes. The New York Central road evidently means business in making improvements, and however dilatory they may have seemed in the past they are certainly now disposed to do everything in their power.

Engines for Central Stations. WITH the growth of the central station for electric light and power, the subject of prime movers for electrical apparatus has come to assume commanding importance. Time was when the ideal of central station managers was a plain high-speed engine, running from one to half a dozen dynamos. Experience has gradually taught better methods and designs, and now the managers of many central stations understand fully the importance of proportioning the size of their power units—both steam and electrical—to the duty of the station and not to the demands of single circuits. For arc lighting it is true that the size of the dynamo is comparatively limited, as the current required being small the whole output is determined by the maximum of electromotive force it is desirable to carry. For incandescence machines, however, no similar limitations exist, and, in any case, there are no special limitations to the size of engine that can be employed other than those imposed by the total size of the station. It is never advisable to put too many eggs in one basket, and such a condition of things exists when it is attempted to operate a central station with so few power units that the crippling of any one of them will seriously interfere with the usefulness of the station. Up to this limitation, however, the fewer units the more economy. On another page we illustrate an example of a modern engine for central stations. The striking feature of the new engine is the departure from the ordinary routine of stationary engine design and a clever adaptation of the principles that are so successful in large marine engines. There are probably no steam engines so effective as those to be found on the great transatlantic liners, and it is almost obvious at first sight that working on land, with stable foundations and convenient coal supply, is more advantageous than marine practice. Another interesting point about the machine which we are describing is that it is intended to work at very high steam pressures, here, also, following the progress of marine engineering. It goes without saying that the higher the steam pressure the greater the economy, other things being equal, and there is no special reason why it should not be raised to the highest point at which successful lubrication is feasible. The Twenty-sixth street engine possesses another good point in that it is made so that any cylinder or combination of cylinders can be used independently of the rest of the machine, thus making it possible to tide over what otherwise might be a total cessation of operations caused by some trivial accident affecting only one of the cylinders. This, of course, by rendering serious accidents more unlikely, enables the safe use of larger power units in relation to the size of the station than would otherwise be practicable. This whole subject is bound to grow into increasing importance as time goes on, and as it becomes necessary to bring central station practice to the highest point of economy that engineering skill can attain.

The Electrician in War. OUR somewhat strained relations with Chili call attention with unpleasant sharpness to the possibility of hard fighting—not an agreeable thing at best, although sometimes, unfortunately, necessary in the present state of international civilization—and the contemplation of such a possibility ought to awaken electricians to a sense of the service that lies in their power to do. Few people outside of the army and navy really understand how great and of how diversified a character this may be. At first sight it appears that the torpedo service is the main field for electrical operations, and, in a measure, this is true. So far as the stationary torpedoes are concerned methods are quite well settled and the practice has been reduced to a science, one, however, which requires a good deal of electrical skill for its proper application. The automobile torpedo involves problems that are a worthy subject for the exercise of the highest electrical skill. So far as the Whitehead and similar missiles of destruction are concerned, there is not much to be done, electrically speaking, for a torpedo of that class is purely a missile discharged from a gun, but supplied with means for continuing its course to an efficient distance under water. Inasmuch as a high initial velocity does not agree with powerful explosives, the falling off in velocity would be too marked if any long range were attempted. With dirigible torpedoes, however, the case is very different. Then one must depend on electricity for steering if not for motive power, and there is room for considerable improvement, both in speed and certainty of operation, two prime essentials. But the function of the electrician is by no means ended with torpedo service, for in the equipment of any modern man of war the electrical apparatus plays a very important part. The modern gun, 20 to 40 feet in length with corresponding weight, cannot be handled by man-power as quickly as the exigencies of service sometimes require, and the choice lies between electricity on the one hand and hydraulic machinery, or donkey engines, on the other. The latter have been very freely in use, the former has made its influence felt often enough to show that it is fully up to its work. The electric motor is undoubtedly better suited to such sort of work than any other kind of mechanism. Since the introduction of secondary batteries every bit of working mechanism is exposed to a formidable fire and must be protected at all hazards. Here the motor, from its very small size, offers a particularly difficult target, and, besides, can be ensconced behind the gun shield, or even behind the gun itself, so that nothing short of a blow sufficient to disable the latter would cripple the motor; and, in addition, the means of communicating power to the said motor are very unobstrusive and exceedingly easy to duplicate. It is a perfectly simple matter to supply it through half a dozen different circuits in parallel with each other, all of which would have to be shot off before the motor went even temporarily out of use. Even then an electric wire can be handled with such ease and rapidity that temporary communication would be re-established very readily although under fire, while if a steam or water pipe were shot away there would be no replacing it during action. The search light, too, comes in for its share of attention, both as a weapon of defense and offense, and more attention should be given it than has yet been done. The destruction of the search light during a torpedo attack would be a very serious calamity, and when one remembers that torpedo boats are usually supplied with rapid fire guns, such a possibility is by no means remote. From a 37 millimetre revolving cannon—a size frequently used for this purpose—nearly a shot a second can be fired; and at half or three-fourths of a mile the accuracy of this weapon is so great as to render hits quite probable, and a single projectile, or a fragment of a shell, would stand a good chance of putting a searchlight out of use. All this points to reduplication of the apparatus on a considerably more extended scale than has usually been the habit, and beside all this there is a question of communication between different parts of the ship, and especially with the conning tower, and here, as everywhere, the convenience of electricity, the readiness with which circuits can be multiplied and re-established, makes its use almost imperative. In case of war the electrician will find plenty to do, both in the way of routine work and improvements, and may play a part of great importance.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

London, Jan. 18, 1892.—Prof. W. E. Ayrton's presidential address before the Institution of Electrical Engineers has been postponed until Jan. 28, owing to the recent lamented death of the Duke of Clarence.

A new chairman of the National Telephone Company has been appointed in place of Mr. Frederick Leyland, who recently died, in the person of Mr. J. S. Forbes. This gentleman is also chairman of the London Electric Supply Corporation.

A well deserved honor has been bestowed upon Prof. Hertz by the Royal Academy of Turin, which has granted him the Brescia premium for distinguished electrical research.

Municipal lighting is taking a firm hold in this country. Wolverhampton, Wallsall and Chester have each decided to spend £20,000 for electric lighting service.

On Monday last the electric lighting of Liverpool was seriously disturbed by a violent short circuit in the mains which caused considerable alarm and convenience.

An Interesting Electrical Suit.

An interesting suit has been tried recently at Salem, Mass., involving a contention between insurance and electrical companies, and the use of electricity as generated at central stations. It was tried before Judge Hammond, of the Superior Court. The facts of the case, as accepted by both parties concerned, are that a serious accident occurred in the electric lighting station at Lynn at 1:45 A. M. on Sunday, Oct. 26, 1890, by which the flywheel of a 500-h. p. compound Corliss engine burst, partially wrecking the building and also crushing in the sides of two other and adjoining buildings. A number of pulleys in the station were broken, a massive masonry pedestal of great strength, forming one of the supports of the main shaft, was raised from its foundation and a fire occurred in the tower. These events followed each other with great rapidity during a space of time which could be reckoned by seconds rather than minutes, and it is not to be wondered at that the four men in different portions of the station and boiler house were probably not in possession of the important facts connected with the action. One of these men was severely wounded, and all were fortunate in escaping with their lives.

The point at issue in the matter is a certain question of cause and effect which involves the liability of insurance companies. In the case just tried, the Lynn Gas and Electric Light Company is the plaintiff, and some 23 insurance companies, holding policies on the building and contents, are the defendants. The actual defendant is the Meriden Insurance Company, whose case is accepted as a test case.

The theory of the plaintiff is that a fire occurred among the wires in the tower of the station, probably caused by short circuits or cross arcs between different wires. The claim is that the divergence of electricity occurring at the fire produced a certain shock upon the dynamos, which, breaking their pulleys, released the load and caused the breaking of pulleys on the main shaft, a piece of which struck the governor on the engine in such a way as to knock off one of the balls and disable it so as to prevent its controlling the engine. It is also considered by the plaintiff that a large piece was driven under the flywheel in such a manner as to break it.

It is therefore claimed that the insurance companies are liable for the whole damage as resulting directly from the fire.

The insurance companies claim that the engine escaped the control of the governor, probably because of a broken governor belt, or that it slipped on account of the failure of the lacings to hold, or the stretching of the belt. From this cause the speed of the engine was accelerated until the flywheel burst.

But it is further claimed that before this rupture of the wheel the speed was such that the electrical machines were revolving at about four times their normal rate, on which account the regulators of the electrical apparatus failed to control the current and caused short circuits. A fire resulted, causing a damage of about $1,100, which the companies were ready to settle.

The plaintiff, however, claims a damage of nearly $9,000, due to the wrecking of the station, the engine and other machinery.

The testimony has been largely that of experts, the principal ones summoned by the Electric Light company being Prof. E. Wilbur Rice, Jr.; Albert L. Rohrer and Isaac F Baker, of the Thomson-Houston company, and Charles F. Pritchard, superintendent of the Lynn Gas and Electric Light Company. The experts summoned by the insurance companies were Charles E. Emery, of New York; C. J. H. Woodbury and Edward Winchester, of Boston. Messrs. Niles & Carr, of Lynn, were counsel for the plaintiff, and J. D. Bryant and Solomon Lincoln, of Boston, for the defendants. The case was given to the jury, and at 6:30 the next morning they brought in a verdict for the plaintiff.

Early in the trial of the case Judge Hammond suggested, in view of the electric and technical points involved, that the case be taken from the jury and tried before referees, but the suggestion was not agreed to.

This case, owing to the novel features of the question raised, has excited a great deal of interest among central station men, who have been watching the progress of the case for more than a year. The report of the accident was given in our columns at the time of its occurrence.

Some Phases of the Alternating Current.

BY G. T. EVANS.

Of all electric manifestations of energy, none give greater promise of wonderful future development than those produced by alternating currents.

The territory of the constant or direct current seems comparatively well explored and indications point to a development along the lines already marked out. Of any radical departure or of any new phenomena there is now but little promise. But the immediate future of the alternating current will show a two-fold expansion. A growth not only of the work produced by the familiar methods of to-day, but also one which will be an opening of the obscure places within which so many of nature's secrets are hidden. The recent marvelous experiments of Mr. Tesla are an example of this latter growth. Unique and startling as they are, however, they show but the embryo, and shadow only faintly the wonders that are to come.

But the practical man's eye is turned with greater interest toward the development of what has proven to be a dividend earner.

One does not need to turn back very far in his memory to recall the time when the alternating current entered fully into commercial life. It was the beginning of that epoch of the most tremendous spreading out of the incandescent system of lighting. Like the seven league boots, it dwarfed distance. It enabled Messrs. Suburb to possess the best artificial light without paying for several tons of copper. It boldly challenged the gas interests in districts which would have beggared the direct current to enter. But what an opposition it met with, both from the public and the profession! Tales of the deadly alternating current glared at us from every newspaper. It was portrayed as the god of destruction—the man who had dropped of heart disease within sight of the circuit had received its fatal shock, and the respected citizen who late at night came into violent contact with one of the poles while endeavoring to find in it an opening for his latch key, blamed for his wounds the next morning the deadly alternating current. Happily this non-endearing term is now obsolete.

Though the alternating current is as deadly as it ever was and not yet a gentleman, we may shake it by the hand with impunity. Absurd prejudices against it have spent themselves and are relegated to the scrap heap. Professional criticism attacked it at every point. It was uneconomical. No meter could be made to measure it. Machines could not be run in multiple. There was no successful motor for it, etc., etc. The economical part of the subject is answered by the increases in size and number of central alternating stations made by level-headed managers. The meter question was soon solved by Forbes, followed almost directly by Shallenberger, who gave a much more practical machine. Running alternators in parallel is not practiced in this country to any extent, mainly for the simple reason that such connection would afford no advantage over the method in vogue. Alternators can be run in parallel, are run in parallel, and it is safe to say that every large alternating station to-day would be running machines in this way were any gain to be accomplished.

That no alternating motor able to compete under all conditions with the direct current machine has yet appeared must be confessed. But alternating motors are by no means in the category of failures. Some of the rotary field type are claimed to possess even higher efficiency than direct current apparatus, and Mr. Hering has shown that the output per weight for a small three-phase motor is greater than that of some direct current machines. The synchronous alternating motor is beginning to get the popularity it should long ago have had. Such an authority as M. von Dolivo Dobrowolsky, whose pronounced bias for rotary field motors makes his statement more striking, says "the transmission of power by means of synchronous alternating current machines need not be uneconomical." The inability of these motors to run at varying speeds has been adversely criticised, but this is one of their greatest features. By far the greater number of power users want an unvarying speed. Manufacturers of steam engines will testify to this. The question of starting synchronous motors has been a bugbear. Dr. Louis Duncan proposed in 1888 to start by means of a direct current from the central station, but this method hardly seems practical, and has not, as I am aware, been put in commercial operation. A much more simple way seems to be that employed by the Westinghouse Electric and Manufacturing Company, in Telluride, Colo., at the plant of the Gold King Milling and Mining Company. Here a two-wire Tesla motor is used to start the synchronous machine and bring it in step with the generator. An accumulator could also be used for the same purpose with advantage.

It will be strange if the synchronous motor is not soon exploited by central station owners. The greater number of these stations are now run in an incomplete way. They are like graveyards in their quietness during the day. They resemble savings banks where deposits draw interest for ten or fifteen hours, and are non-productive during the remainder of the day. Synchronous motors would change these conditions. They could be connected directly to the primary lines, and the connections so inclosed that no one without an ax and a suicidal intent could come to harm. A circuit breaker would prevent an excessive flow of current due to closing circuit when motor was not in step with generator. By connecting to primary lines cost of transformers would be saved, together with loss by conversion and the constant hysteresis losses of the transformer. Probably a motor, with its necessary starter, would be more costly than one of the direct current type. But the station management would be wise to make up this difference and so be able to run full time and with a better average load than is now had with lights alone. It should be the aim of every central station manager to run at the point of economical capacity at all times. The use of synchronous motors on a circuit being changed from one generator to another would require parallel running, for a synchronous motor suddenly deprived of its working current and changed to one of opposite phase would cause a very unpleasant incident both for the customer and the power seller.

Alternating dynamos of low pressures seem destined to encroach on the precincts of isolated direct current plants of any large size. The commutation of large currents is not always a pleasant nor a strictly successful undertaking, while the commutation of the comparatively small amount necessary for field excitation is untroublesome and easy of accomplishment. Of course unless the exciting current was taken from the main armature an extra machine would be required, but this addition would be more than compensated for by the absence of the trouble and annoyance so often present with the commutator on a large direct current machine.

Long distance power transmission is the feature of alternating work attracting most attention to-day. The transmission of power from Lauffen to Frankfort, more than 100 miles, was the event of practical alternating work for 1891. The transfer of energy by alternating currents from Niagara Falls to the Columbian Exhibition in Chicago is talked of, and one of the principals of the Lauffen-Frankfort transmission plant is reported as being willing to bid on a contract to carry either 1,000 or 5,000 h. p. this distance, the potential to be between 40,000 and 50,000 volts. But to carry this amount of power a distance exceeding 500 miles and at a pressure so high is as yet problematical.

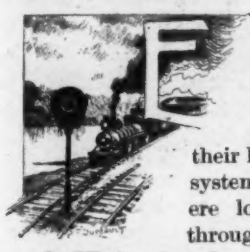
No doubt this power could be carried between these widely separated points; for that matter ten times the amount could be sent to the antipodes. But unfortunately the profitableness of the scheme cannot be overlooked. Even with such a pressure as 50,000 volts, and the success of this voltage over a long line is as yet very uncertain, though some 30,000 volts were used at Lauffen and 40,000 have been experimented with elsewhere. The cost would be considerable. Beginning at Niagara Falls and following the route of the N. Y. C. R. R. to Buffalo, and thence the L. S. & M. S. R. R. to Chicago, passing through such cities as Erie, Cleveland, Toledo, etc., the distance in round numbers, plus three per cent allowed for sag of wire, is 580 miles. Supposing the pressure at the secondary of the Niagara Falls transformer to be 50,000 volts and allowing a loss on line of twenty per cent. due to resistance and a loss at the Chicago transformer of ten per cent., and leaving loss by leakage out of the calculation, it is found that a copper wire, about one-third of an inch in diameter or of a size approximating No. 00 B. & S. gauge would be required to deliver 1,000 net horse power to the motor at the Fair. The weight of this wire would be about 1,250 tons for a synchronous motor. If the loss on line was thirty per cent., the size of wire would be reduced to about No. 0 B. & S. gauge and the weight to less than 1,000 tons.

Whether any company will see in this temporary installation a result justifying the expense is not likely. But it is impossible to predict what enterprising Chicago will do, and if the power of her Lake Michigan returns to her on a strand of wire and one more wonder is added to her list, Chicago will occupy even more territory in the English language than she does now.

Should the power of Niagara Falls be utilized, as is promised, and if it be sold at a reasonable rate, Buffalo bids fair to become *the* electrical city. It is not 25 miles from the Falls and electrical energy in 1,000 h. p. units (providing a potential of 50,000 volts was used) could be carried into the heart of the city with a loss of ten per cent. on the Buffalo transformer and but two per cent. loss on the line with a No. 4 B. & S. copper wire weighing about 15 tons. With a loss of ten per cent., a wire but little more than one-tenth of an inch in diameter would be sufficient—the weight of which would not be four tons. This immense amount of energy because of its high pressure would require no more current than 20 ordinary 50 volt 16 c. p. lamps. Who can estimate the results of these possibilities?

In Buffalo will the beginning of that revolution be which the electrical world dreams of but as yet sees but dimly. Steam power will give way to electrical power. The electric light will fight a winning battle with the kerosene lamp—with the tallow itself, and electrical heat will no longer be an expensive luxury but one within the means of all.

Electric Block Signaling on the New York Central.



EVERY one knows that the authorities of the New York Central Railroad are now thoroughly aroused to the importance of hastening the completion of the equipment of their lines with some adequate block signal system, and appearences indicate that ere long that line will be protected throughout its length.

On Wednesday, Jan. 13, a very interesting tour of inspection was made over the Hudson Division of the road as far as Peekskill by a small party of those especially interested in electric block signaling. The purpose was to inspect the operation of the various systems now in use, with more special reference to the new Hall signal system now in use in the vicinity of Peekskill. The party consisted of Mr. W. P. Hall and Mr. Brewster, of the Signal Company, Dr. Bell and Mr. Outcault, of THE ELECTRICAL WORLD, a manager of a prominent Western road, and Mr. Smith, assistant to Supt. McCoy of the Hudson Division.

It was a trip full of interest and gave a better insight into the actual working of the signals in a very crowded portion of the road than could possibly be obtained by any description. About noon the special observation engine "Hudson" pulled out of the Grand Central station carrying the party, which was soon lost to sight in the smoke and fog of the tunnels. A trip through two miles of tunnels creates a vivid impression of the difficulties that have to be overcome—difficulties only imperfectly understood by the public, but far greater than are to be encountered, probably, in any other tunnel in the country. Fig. 1 will bring the reader to a realizing sense of the way things look from an engine in the tunnel. Throughout its entire length it is worked on the Sykes block system, and, besides this, special precautions in the way of extra signals and torpedo signals are taken to prevent any possibility of the occurrence of such an accident as that which startled the public about a year ago.

The utter futility of any attempt effectually to light the

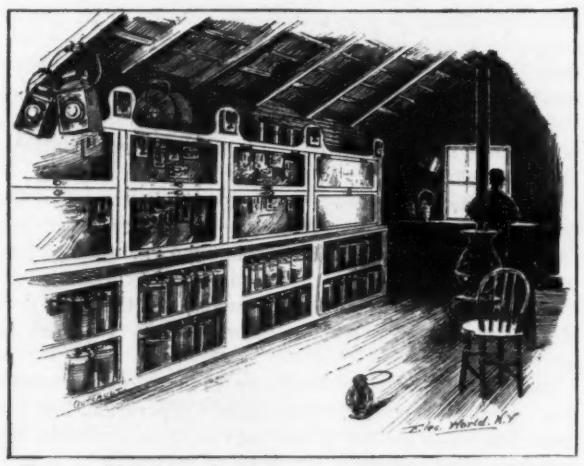


FIG. 1.—VIEW OF INTERIOR OF THE BATTERY HOUSE.

tunnels in their present smoky condition is strongly impressed on the mind. With trains during part of the day running through them every half minute, the amount of smoke that is mixed with the damp air of the tunnel creates a low-lying heavy cloud that defies illumination. The practiced eye of the engineer can detect the condition of the signals much more readily than would be possible for any layman, but the alternations of light and darkness are somewhat confusing, and as the engine plunges from the tunnel into a sudden opening the reflected glare from the smoke cloud renders futile any effort to see beyond; a moment and this is over, but the smoke, always present and always annoying with so many trains running through the tunnel, must steadily be produced in great quantities, and it does not seem as though any system of ventilation short of opening the tunnel its entire length could completely remove the difficulties that are experienced. As it is, the signals are placed comparatively low along the track and are fully adequate, with the additional precautions taken, to secure the safe running of the trains under any circumstances. But the speed is necessarily rather low, and if service through the tunnel is to be expedited something further should be done. It seems probable that it would be feasible to handle the tunnel traffic with electric locomotives, in which case all the signal difficulties would at once be eliminated, but anything short of this, with the tunnel as it is at present, can be regarded only as a palliative measure.

A little beyond the tunnel the electro-pneumatic system comes into use, and in addition for a long distance there are a series of mechanical signals to facilitate the safe conduct of the trains. Both the Sykes and pneumatic systems of block signaling seem to be especially adapted to short blocks for purely mechanical reasons, and it was therefore with much interest that the Hall signals—beginning at a point a few miles below Peekskill—were inspected. They have been in use for a year or so, but recently the system has undergone an entire revolution of so sweeping a character as to leave hardly a remnant of the old arrangement aside from the signal posts themselves. In the first place all automatic block signals heretofore in use in this country, or elsewhere, have been constructed on the following general principle: all the block signals, whatever the length of section to which they apply, stand normally in such a position as to indicate that the track is clear, except when the signal at the beginning of the block is set at danger by the entrance of a train upon that section; as the train passes on and enters the next block, the section behind it resumes its normal position of clear. One can then look on the train as continuously setting the signal behind it to danger during its progress over the line. Of course all the signals are so arranged that in case of any failure of the operating apparatus, they are set at danger, so that, unless there is some special mechanical reason for the signal failing to operate at all—for example its being mechanically stuck by grit or sleet—then it will work in the way intended.

This arrangement of signals is disliked by many railroad men as placing too much reliance on a single signal that is set to danger, and the best European practice shows a

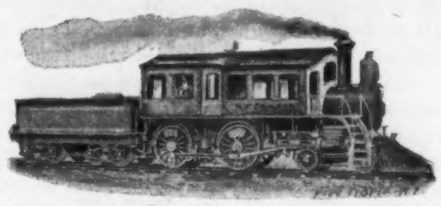


FIG. 2.—SPECIAL INSPECTION ENGINE.

totally different system. In this latter arrangement all the signals on the line stand normally in the danger position, and are cleared by the approaching train in case the track beyond is actually free and unobstructed. It is this last device that the Hall Signal Company has adopted, at the suggestion of Superintendent McCoy, very recently in connection with other considerable changes.

A few miles below Peekskill the party reached the first of the signals operated on the new system, and soon reached its destination, where a stop was made for better inspection of the signals. The signals displayed both for day and for night are shown in Fig. 3.

It will be seen that the ordinary semaphore arm is dispensed with, and an enclosed signal is employed boxed up in a large and plainly visible signal post having an aperture 18 inches in diameter covered with glass, behind which the danger signal—a red disc 16 inches in diameter—is set by a special form of long-pull electromagnet. The point that has often been raised is the relative visibility of the semaphore and this enclosed signal; the day of inspection was foggy, and gave therefore, a good opportunity of determining this particular point. As a matter of fact, the condition of the signal was visible as soon as the cross bars on the neighboring telegraph poles, which may be considered as fairly representing semaphore arms. On a clear day the condition of the signals ought to be easily visible at the distance of a thousand yards.

The arrangement for day and night signals is well shown in the cut. For the day signal reliance is placed on the aperture and disc. The aperture extends entirely through the signal box, being enclosed with glass on both sides, and behind the signal is a screen painted white to furnish a good background, against which to see the disc; in addition the latter is smaller in diameter than the aperture, so that the danger signal appears as a red circle surrounded by a white ring; a device which considerably increases the visibility. When the signal is clear a full white circle 18 inches in diameter is exhibited.

Night signaling is accomplished by a subsidiary aperture just above that used during the day. Behind it is placed an ordinary signal lantern, and a red glass disc carried by an extension of the same arm that carries the day danger signal provides the means for showing the danger signal at

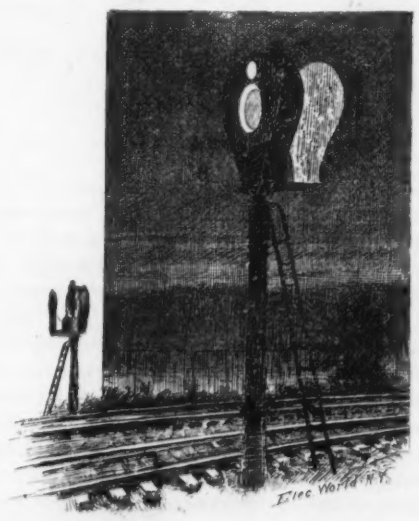


FIG. 3.—SIGNAL POST.

night. The enclosed signal is thus fully described because it is so radically different from the forms generally employed. At first a prejudice existed among engineers against the enclosed signal, but experience has taught them, wherever it has been applied, that it is easily seen.

Now as to the automatic arrangement of the signals. In the final form of the Hall apparatus the old wire circuit and track instruments operated by the wheels of the passing train have been totally abandoned, and reliance is now placed on the track circuit. The rails of the tracks are bonded, much as in electric railway work, and each block is insulated from the next. Two cells of gravity battery are connected on a closed circuit through the rails and through a relay which serves to throw in the local battery which operates the signal apparatus proper. Now, when any train or car enters a section of the track thus connected, its wheels and axles short circuit the battery, thus dropping the relay armature and throwing in the local battery.

It is found that with two battery cells in series leakage never rises to an amount considerable enough to interfere in the least with the proper operation of the system when ordinary ballast is employed. Slag or cinder ballast, however, has conductivity enough to render the track circuit inoperative and compel a return to independent circuits. No track circuit arrangement can stand slag or cinder ballast without going to the inordinate trouble of insulating the rails.

The batteries are located at convenient points where they can be readily attended to. One of the little battery houses operating a large number of signals is shown in Fig. . The cells that operate on closed circuit require attention about every three weeks, while the local batteries will last for several months without renewal.

So much for the general method. The system now adopted by the Hall company, which is rapidly being put in operation on all their signals, employs this direct circuit in connection with signals normally at danger, as before described. The action is, roughly speaking, as follows: Each train by the device just mentioned clears the signal at the entrance of the block which it is approaching, provided the tracks of that block are not already short circuited by the presence of another train, or even a car. Thus as a train goes on its course it continually clears the danger signal if the track is clear and drops the home signal to danger again as it passes out of the block.

The apparatus is so arranged that any failure on the part of the mechanism will keep the signal at danger and prevent its being cleared by any approaching train.

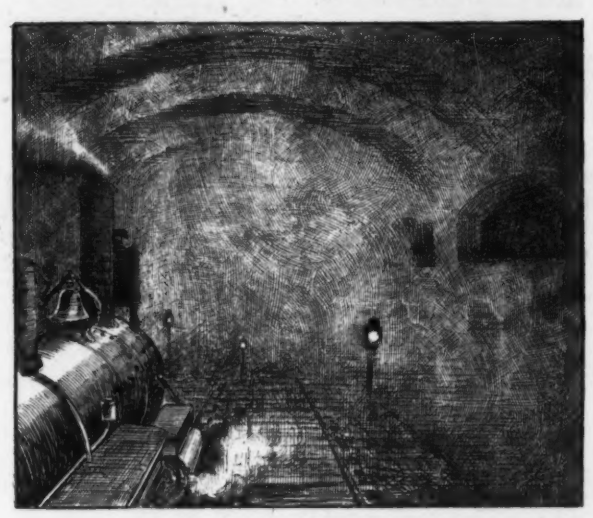


FIG. 4.—VIEW IN THE TUNNEL.

It may be noted in addition that if by any accident the track should become discontinuous the signals guarding the entrance to that block would stand persistently at danger. A broken rail, for example, would thus make its presence noticeable, for, as rails are usually broken, there would be discontinuity in the metallic circuit. It is obvious that this very simple electrical apparatus is particularly convenient for use on long blocks where wires or rods mechanically operated, or devices for the conveyance of compressed air for operating pneumatic signals, would be rather expensive and somewhat inconvenient. It is for this reason that it can be advantageously used in combination with the systems already existing in yards or near stations.

In and about the station at Peekskill are several neat devices belonging to the Hall system. One of them is a crossing bell automatically set ringing by a train at any desired distance from the crossing and kept in continous operation until the train passes the crossing, and switch instruments to signal the position of switches about the station. These are special mechanisms and are somewhat aside from the immediate subject of block signaling which is under consideration.

After the stop at Peekskill the party re-entered the waiting engine and returned home, running rather more slowly than on the up trip on account of the more frequent train service that had to be dodged by the extra engine.

It will thus be seen that there is an abundant diversity of automatic block signal systems fully capable of adequately protecting even lines where the traffic is so congested as on the New York Central, and the interest taken by the officials of that road in this trip of inspection is abundant evidence of their desire and intention to proceed actively in the solution of the problem that has recently been placed before them with such terrible force. They mean business, and in all probability a few months will see an electric signal system of some sort guarding the entire length of their line. Just what it will be they have not yet determined, possibly a combination of the systems may be used, but one thing is sure, that ere long only a most extraordinary series of mishaps could render possible such an accident as that which horrified the public and appalled the officers of the railway a few weeks since.

Elements of Practical Electricity.*

BY DR. LOUIS BELL.

You are now fairly launched on the subject of electrical measurements, and, as you have seen and will see, they are dependent on Ohm's law for the most part, and are rather simple. In the actual operation of making an electrical measurement you frequently only have to determine a single quantity, from which the required result can be readily computed. Sometimes the case gets a little complicated, as when, for example, there are two unknown quantities which you wish to find. Two experiments will usually enable you to obtain both of them rather simply. There are certain stock measurements, so to speak, that turn up in all kinds of electrical work, and with which you should now become tolerably familiar in their practical applications.

The resistance and electromotive force of a battery is a familiar starting point in laboratory practice. The problem is really a very simple one. You will see at once that if you could find in any way the resistance of the complete circuit through your galvanometer and battery you could educe your electromotive force immediately, but you do not know the resistance of the battery itself. As a matter of fact you can in a single experiment find this, and then use it to determine the electromotive force of the battery First you must find the resistance of your galvanometer. This you can very readily do, inasmuch as you know the length of wire which you wound upon it, or can easily measure it from the dimensions of the ring, and you also know the number of feet of that particular wire that is equivalent to an ohm resistance. Now, to find out the resistance of your battery and consequently its electromotive force, you must proceed as follows: The general principle on which you are going to work is to find the effect of a change in the resistance of the external circuit, and from it compute the total resistance of the entire circuit, and hence that of the battery, inasmuch as you already know all the external resistances.

Connect your battery—a Daniell cell preferably—to the galvanometer through a resistance, taking for the purpose one of the coils you have constructed; choose such a resistance that the deflection will be in the neighborhood of 45 degrees; call the resistance of the galvanometer G, that of the battery B, and the resistance you have put in the circuit R. Now, from Ohm's law you know that the current which flows equals the electromotive force divided by the total resistance, and that it also equals $K\,H \tan a$ from what you have already seen of the tangent galvanometer. Therefore you can write the equation of Ohm's law for this particular resistance as follows:

$$(1)\quad K\,H \tan a = \frac{E}{B + G + R}.$$

Of these quantities you know the values of all except B and E. Now insert more resistance in the external circuit of the battery, adding another coil so that the deflection will be reduced 10 or 15 degrees; call this new total resistance, aside from the battery and galvanometer, R'. You now will get another deflection and you can write,

$$(2)\quad K\,H \tan a' = \frac{E}{B + G + R'}.$$

From this you can obtain the battery resistance, for dividing 1 by 2, member for member, E is eliminated, and you have the following explanation for the relation between the high resistance and the other and unknown quantities

$$\frac{B + G + R'}{B + G + R} = \frac{\tan a}{\tan a'},$$

which simply explains the effect on the deflection produced by changing the resistance from R to R'. Reducing this fraction

$$B = \frac{R \tan a - R' \tan a'}{\tan a' - \tan a} - G.$$

G, the galvanometer resistance, you know, R and R you know, and the deflections you have observed. You thus have the resistance of your battery and by substituting its value in either (1) or (2) you can immediately obtain the electromotive force of the battery, since you know the total resistance of the circuit.

This method of making the measurement of battery resistance is a convenient one for approximate purposes; in case extreme accuracy is required there are better ways of doing it, but for ordinary purposes this is quite sufficient. The electromotive force of the Daniell cell will be found to be between 1 and 1.1 volts, and any variations outside of these limits is an evidence that you have not been careful in your experiments.

THE MEASUREMENT OF VERY LOW AND HIGH RESISTANCES.

Before passing to the common methods of measurement of resistance we may very well consider the means taken in measuring very great or very small resistances, inasmuch as in theory they are extremely simple, depending directly upon simple modifications of Ohm's law, which you already understand. For example, suppose you desire to find the resistance of a short piece of comparatively thick wire, a resistance perhaps amounting to only a few thousandths of an ohm. You have already seen that when a current flows through any conductor the fall in potential between its ends equals the current multiplied by the resistance. In other words, if the same current is flowing through any two conductors the drop in potential that takes place in each of them is directly proportional to its resistance. If one of the resistances be known, and you can find the fall in potential between its terminals, a similar measurement of an unknown resistance will give you the value of the latter by simple proportion.

In practicing this method you need a potential galvanometer, such as has been previously mentioned, and in the next section of this paper the construction of such an instrument will be described. For the present, however, you have only to consider the way of using it, which is as follows: Connect your low and unknown resistance to a Daniell cell in series with a known low resistance, such as you can easily make by cutting off a thick piece of wire, of which you know the approximate resistance per foot. The same current now flows through both conductors. Connect the terminals of the potential galvanometer, first from end to end of one resistance and then from end to end of the other. You will then have obtained two deflections, the tangents of which are proportional to the falls of potential through the two resistances, and inasmuch as these falls of potential are directly proportional to the respective resistances, one of which you know, simple proportion gives you the unknown resistance you are desirous of determining.

The resistance of the galvanometer must evidently be so high compared with the rest of the circuit that the minute amount of current which flows through it will not disturb the conditions in the rest of the circuit enough to produce any sensible error. With an ordinary potential galvanometer these conditions are fulfilled.

THE MEASUREMENT OF HIGH RESISTANCES.

In measuring very high resistances an equally simple method can be employed provided you have a known high resistance and know the resistance of your galvanometer. The process is as follows: Connect the resistance you wish to determine in series with your galvanometer, observe the deflection, then take out the unknown resistance and substitute for it a high known resistance, noting the deflections in this case also. In the first place you will have

$$K\,H \tan a = \frac{E}{R + G}$$

In the second case

$$K\,H \tan a' = \frac{E}{R' + G}.$$

R' is the known high resistance. The resistance of the battery you can drop out of the question entirely, because it will always be small compared with the rest of the resistance and hence can be omitted without any noticeable error. From these readings the computation of the unknown resistance is made in an obvious way.

For ordinary resistances neither of the methods just described is so accurate or convenient as another which is in general use. This is known as the "bridge" method and depends on the fact that no current flows between two points at the same potential. In the methods you have just seen two readings of the galvanometer have to be made, in either of which there is a possibility of slight error. By the bridge method resistances when known are balanced against unknown resistances in such a way than when the two were exactly equal in amount no current whatever will flow through a sensitive galvanometer; hence there are no readings of deflection to be taken in which you can make errors, the only thing to be determined is the simple fact of there being no deflection at all when the circuit—including the galvanometer—is made or broken. Such methods are called "null" methods, and are always to be preferred to those involving two or three readings of deflections, inasmuch as the chance for error is much reduced.

In the next paper we will see how to construct the necessary apparatus for carrying out the every day measurement of high resistances, including the construction of a high resistance galvanometer of great sensitiveness which would be required for the work.

(To be continued.)

* Continued from The Electrical World of Jan. 16, 1892.

1891 in England.

(From a London Correspondent.)

Whatever else may be remarked about the year 1891, it cannot truthfully be said to be altogether devoid of electrical interest. The year which has seen Ewing's plausible and far-reaching theory of magnetism more fully enunciated and extended, and has witnessed the brilliant experimental demonstrations of Prof. Crookes, Prof. J. J. Thomson and Mr. Nikola Tesla could not be voted dull even by the most hardened cynic. Early in January Prof. Crookes' inaugural address to the Institution of Electrical Engineers was embellished by a number of highly interesting and original experiments on the behavior of electricity in vacuo. Later on the experiments of Mr. Nikola Tesla were noised across the Atlantic, while Prof. Thomson was carrying on at Cambridge a not less useful, if more quiet, series of investigations into the electrical properties of vacua. Early in the summer the centenary of Faraday's birth was celebrated with much éclat at the Royal Institution, lectures being delivered by Lord Rayleigh and Prof. Dewar on the physical and chemical aspects of Faraday's researches. In the closing weeks of the year Prof. Dewar has been enabled to give experimental demonstration of the fact that at a temperature of minus 180 degrees centigrade oxygen (in a liquid form) becomes strongly magnetic and will adhere to the poles of an electromagnet.

A year ago it was difficult to foresee whether our local authorities meant to undertake electric lighting in earnest or were merely dallying with the question in order to keep others from dealing with it. At the close of 1891, however, there can be but little doubt that municipal electric lighting has come to stay. Although about one hundred orders have been obtained and only some dozen or so local authorities can be said to be at present seriously taking the matter up, still we must remember that large bodies move slowly and we must make allowances for the red tapeism rampant in the parochial mind and the natural hesitation that local men feel in encountering the criticisms of constituents unfriendly to the new illuminant. Early in the year Dublin decided to adopt the alternate current transformed system of electric lighting. Glasgow, perhaps on the principle that in the multitude of counsellors there is much wisdom, availed itself of the advice of Sir William Thomson, Prof. Jamieson and Mr. R. E. Crompton on the question of the merits of high and low pressure systems respectively, meanwhile not disdaining to give heed to the gratuitous advice given in a local newspaper. Having become thoroughly confused and perplexed by the contrary counsel received, the corporation finally appealed to Prof. A. B. W. Kennedy. Some two years ago Bristol, after much deliberation, took the advice of two well known consulting engineers, and last March the sum of £66,000 was voted toward a 10,000-light station to supply alternate current transformers and furnish current to 100 arc lamps for street lighting. Although the Bristol electric lighting provisional order was obtained in 1883, the final details of the central station are even now still under consideration. Manchester and Nottingham have decided to spend large sums of money on electric lighting, and Manchester apparently leans toward the complication of a five wired system. Huddersfield has already entered into a contract with the Brush company for the erection of a central station. During the fall of the year two municipal stations have come into operation, viz., St. Pancras and Brighton. At St. Pancras in North London all appears to be going on well, but at Brighton the original estimates have already been exceeded.

In London electric lighting is making steady advance. In February last Deptford recommenced its high pressure supply at 10,000 volts. Four more central stations have been built, bringing up the total capacity of our metropolitan stations to 550,000 lights. A year ago it was estimated that about 180,000 lamps were connected up to the London mains, now it is conjectured that the number reaches something like 300,000.

Electric traction also has not been stationary. The City & South London Railway, in spite of an accidental stoppage, has proved so satisfactory that the system is proposed to be adopted in some half a dozen projected London railways. At Leeds, we have, owing to the energy of Mr. Groth Baker, a representation of how cars are run by you.

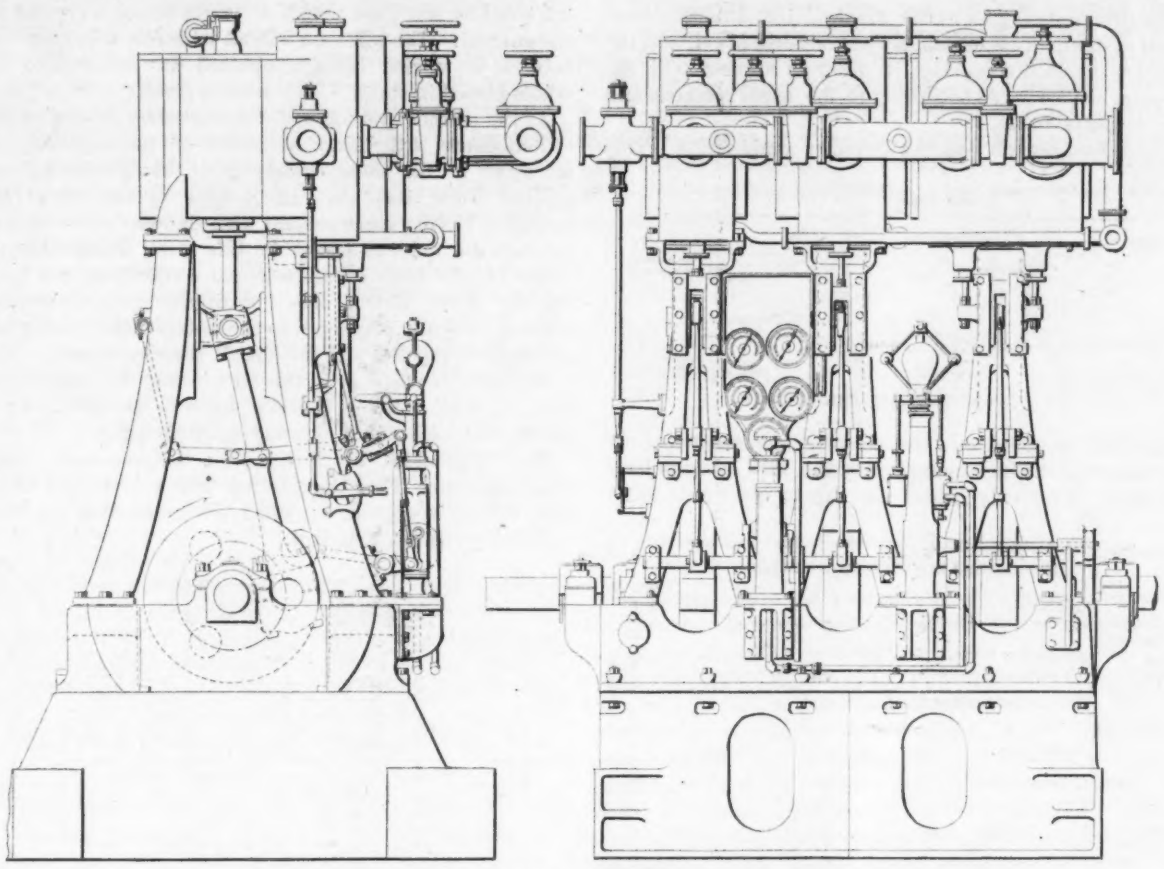
The Liverpool overhead railway is fast nearing completion and the Electric Construction Corporation has contracted to work the line at the rate of 3½d. per train mile for locomotive expenses.

Legal contests have happily been neither numerous nor very serious. The action of the British Tanning Company against Mr. Groth practically turned on the seemingly trivial point as to whether a *revolving* drum containing a stationary framework of hides was the mechanical equivalent of a *stationary* drum containing a revolving framework of hides, the object in either case being to cause a motion of the tanning liquor among the hides. It was held that the Groth process did not infringe that of the British Tanning Company, and the Worms & Balé patent was also invalidated on a point of law. Subsequently, however, it was rehabilitated by a special Act of Parliament. Mr. Lane Fox has up to the present tried in vain to come to close quarters with the supply companies so far as the question of the validity of his distribution patent is concerned. Although Mr. Brush has recently secured a success with you by being declared the true inventor of the pasted accumulator, with us his claim to be the inventor of compound winding is still *sub judice*.

An epoch has been marked during the year in the history of telephony, by the establishment of the first submarine telephone line. This latest link between London and Paris had long been under the consideration of Mr. Preece, the electrician to the British Post Office, and, as a result of careful designing and thorough workmanship in the erection of the lines on both sides of the English Channel, the speaking from the first has been excellent. The following figures, which have recently been published, will give some idea of the way in which the line is appreciated. The number of telephonic messages of three minutes' duration was 1,222 in April, 1,491 in May, 1,709 in June, 1,988 in July, 2,276 in August, 2,311 in September and 2,732 in October, making a total of 13,729 messages, representing receipts to the amount of over £5,000. The London telephone service still evokes much discontent in consequence of the cross talk and other disturbances on the lines, and it is just possible that the question may be solved by the acquisition of the telephones by the government. I have endeavored to glance briefly at all the principal electrical events of the year. It is obvious, however, that to deal in anything like a thorough manner with the question would require far more space than that usually devoted to a communication of this kind.

New Triple Expansion Engine for Electric Light Stations.

We illustrate herewith a fine example of a triple expansion non-condensing engine for generating electric current which is now in operation at the Twenty-sixth street Edison station, and is intended to be direct connected to large multipolar dynamos, although for the time being it is belted to two No. 60 Edison bi-polar machines placed overhead. This engine has already been in operation some weeks and has turned out to be so satisfactory in every way that it is probably only the first of a very large number of similar machines that will find their way into central stations for electric lighting and power. Of the great desirability of employing triple expansion engines there can be no question whatsoever, and they are certain to find their way into every installation of sufficient size to justify their use. Of course such machines can be employed either to handle a large proportion of the dynamos in a station, as, for example, in the new West End power station in Boston, or they can be direct connected to large size dynamos.



SIDE AND FRONT ELEVATION OF THE VAN VLECK VERTICAL ENGINE.

Wherever the size of station is sufficient to permit several of these colossal dynamo units to be employed their use is of great advantage, both in economy of coal, attendance and in space occupied; the only disadvantage is in the case where the station capacity is not sufficient to allow employing a sufficient number of such units so that an accident to any one of them may not cause serious results. Any engine is liable to break down, but in the case of the engine we are describing the chance of the whole engine being disabled is extremely remote, on account of its being built on a disconnective principle which enables the engine to run and carry its load with any of its three cylinders out of gear. This feature does away with much of the objection to large units.

The Van Vleck engine is a particularly good example of a disconnective triple engine for central station work, and was developed under the auspices of the Edison Electric Illuminating Company, of New York, by Mr. J. Van Vleck, who has been ably assisted in his important work by Mr. David Joy and Mr. S. F. Prest, of London, while the details were admirably worked out by Mr. J. W. Sargent, of Scranton.

The general design, as seen from the illustration, is that of the inverted cylinder type, and, exclusive of the overhanging shaft, the engine occupies less than one-tenth of a square foot per horse power. Indeed, it would be hard to imagine a more compact machine, unless it were arranged with two of the cylinders in tandem, a form of design frequently considered objectionable.

The great gain in space is obtained by placing the steam chests in front of the cylinder instead of between them as is so often done. This feature of occupying very little floor space is of particular value in large city stations, as it allows, it is said, being placed in a given space over 30 per cent. more power than in the case of the ordinary triple engine with steam chests between the cylinders.

The general construction of the engine is such that it can be applied to any size from 500 h. p. up. The first machine here illustrated will develop, according to the steam pressure, from 600 to 1,000 h. p., and the general features of its design have proved so thoroughly practical that it will probably not be altered for the large sized engines which are now being constructed for the Pearl and Elm streets stations of the Edison company.

All the regulating and valve gearing is placed on the front of the engine, where it can be seen and reached with the greatest ease. The operating engineer need but seldom go behind his engine or between the columns, as is so often necessary with the commoner types. A very useful and unusual feature is found in the governing arrangement. The point of cut-off is automatically controlled simultaneously on all three cylinders, adjusting them to the proper working for a given load immediately. This tends to keep the engine working at its best all the time and gives it the ability to respond more quickly than is usual to the governor. The valves are all positive driven, while the point of cut-off is controlled by a very sensitive hydraulic governor.

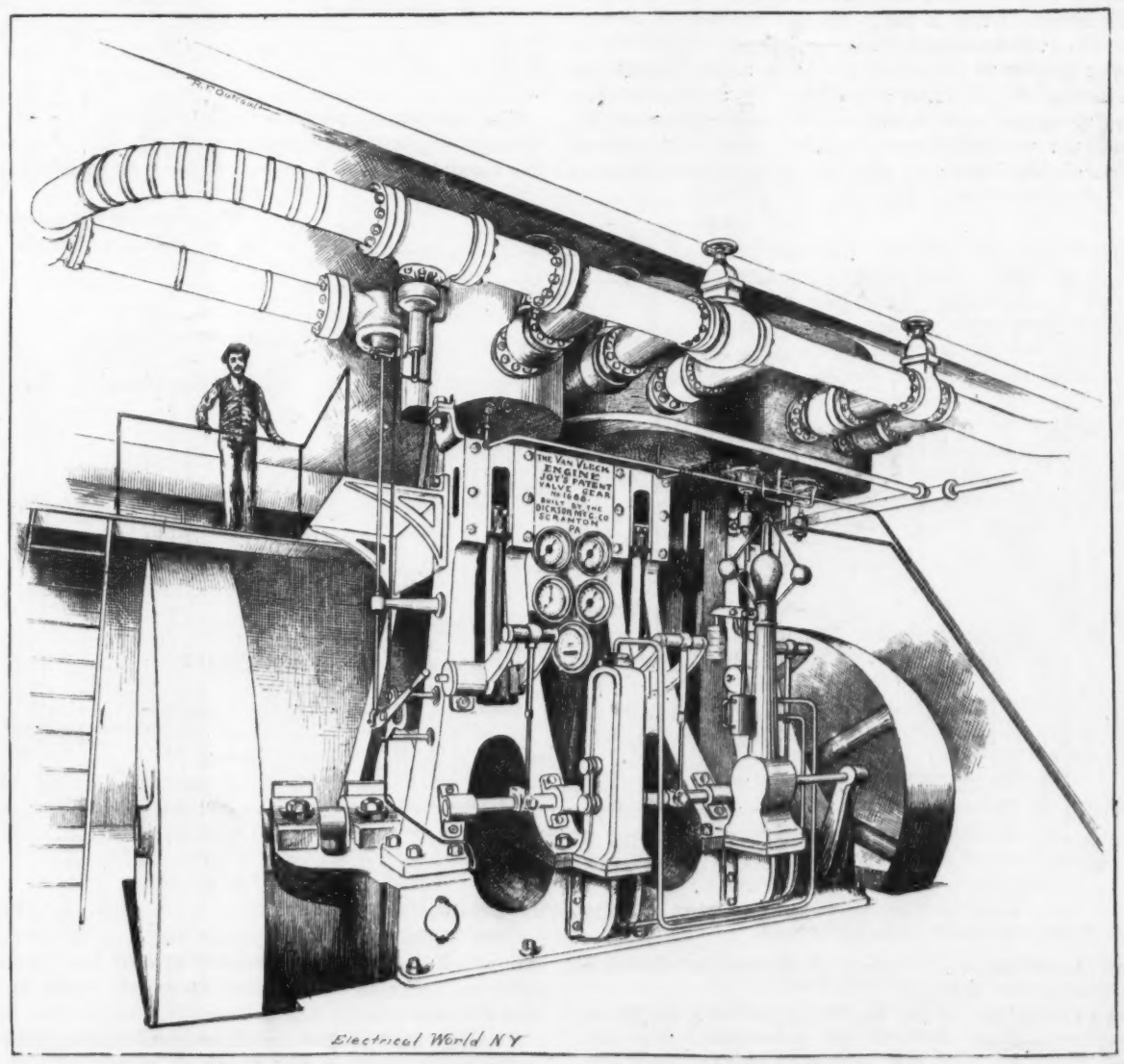
Another novel point that will be thoroughly appreciated by skilled engineers is that the exact point of cut-off in each cylinder is indicated on a dial on the cylinder in plain view, so that a glance can tell much of the performance of a machine that ordinarily would have to be ascertained by taking indicator cards. The point of cut-off in any cylinder can be easily altered, even while the engine is running, a feature which in practice has already proved its usefulness.

The engine at the Twenty-sixth street station was started up under load when steam had been flowing through it for only 15 or 20 minutes altogether, and was obliged to carry load even when the intermediate cylinder was unable to run and was disconnected. Under such circumstances the ability to adjust the cut-off to the proper point to meet these new conditions without shutting down was of great value. Nearly all the necessary valve adjusting was actually done under load when the engine was running, although it had never been turned over or adjusted at the shop previous to being placed in its final position.

The speed can also be easily adjusted with the engine in motion, which is sometimes necessary to be done when the dynamo circuits are shifted to feeders needing higher pressures. Another interesting feature of the Van Vleck engine is that all the main bearings and main guide surfaces are water-jacketed, so that they can at all times be kept cool and therefore lessen the risk of breakdown, even when to secure continuity of service it is necessary to run under unfavorable conditions.

The general construction is thoroughly workmanlike. All the oiling is accomplished from tanks which distribute the lubricant in proper amounts all over the engine in accordance with what is now standard marine practice.

It is fitted with the Joy valve gear, which, besides being in wide use in marine service, is rapidly being adopted by British railways. The engine is made by the Dickson Manufacturing Company, of Scranton, and it is a promising example of recent high efficiency land engines.



PERSPECTIVE VIEW OF THE VAN VLECK VERTICAL ENGINE.

A New Primary Fuse Box

The Stanley Electric Manufacturing Company, of Pittsfield, Mass., is putting on the market a new primary fuse box, the result of a demand for the same style of box as on the Stanley transformer, but separate from it. The points of advantage claimed for it are that it is of double pole and each fuse is in a separate porcelain chamber, so that when a fuse blows there is no danger of the current short circuiting from one pole to the other. A fuse can be replaced on a live line with perfect safety and in a very short time, and the use of a screwdriver or wrench is entirely unnecessary. The porcelain plugs in all boxes are interchangeable, so that by having an extra plug or two no work is necessary while on the pole.

Whenever a branch is taken off from the main primary wires it is very desirable to fuse it, so that if a short circuit occurs on that branch the lights supplied by it will alone be affected. If the fuse is not so used, a short circuit anywhere on the primary wires may blow the main fuses in the station, and so occasion a much more serious interruption to the service.

The Stanley fuse box here described is for use on primary circuits carrying current up to 15 ampères (300 lights on 1,000 volts, or 600 lights on 2,000 volts) and its interior construction is the same as the fuse box on the Stanley transformer already described in the columns of THE ELECTRICAL WORLD.

The Electric Lighting of the French Battle Ship Marceau.*

BY LIEUT. HAMILTON HUTCHINS.

The electric lighting on board the Marceau is supplied by four Gramme tripolar dynamos, of the type H. C. of the firm of Sautter & Lemonnier, driven by vertical engines. Each of these dynamos is of 200 ampères capacity at 70 volts.

Two of these machines are in one of the forward compartments of the ship on the lower orlop deck. The other two machines are in one of the after compartments on the platform of the hold. In each dynamo room is located a switchboard. These switchboards receive directly the current coming from the two machines of their respective compartments, and by means of two cables called in Fig. 1 "cable joining the switchboards" they can also receive the current coming from the other two machines.

Fig. 1 shows this entire arrangement, the figures placed near the contacts indicating how the handles of the commutators can be placed in each case. These commutators, four in number, are located two above each switchboard.

The two switchboards are alike in every respect, and the distribution in both incandescent and projector circuits can be from each of the switchboards as desired, in part from each or altogether from one.

The "cables joining the switchboards" are run, one on the starboard, the other on the port side, along the side of the ship in the waist and all situated so as to be accessible. These cables run through a series of nine watertight compartments. The cables are run in wooden moldings and in traversing each bulkhead they pass through stuffing boxes secured to each side of the bulkhead. The stuffing boxes

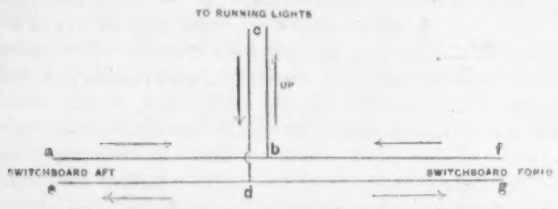


FIG. 2.—CIRCUIT OF THE RUNNING LIGHTS.

are lined on the inside with wood and are made watertight by leather glands.

Besides the "cables joining the switchboards," these moldings contain: that on the port side 11 secondary conductors and that on the starboard side 13. In this study we will reserve the name of primary conductors for those which take the current from the dynamos to the switchboards. (See table in next column.)

No branch circuit is taken off directly from these conductors. Conductors of the same diameter, however, are joined to them at different points, and serve to lead the current to the different apparatus. The conductors running along the waist merely establish communication between the two switchboards and the circuits to be utilized. These circuits begin only after the points of junction have been passed, namely, at points of distribution shown by the permutators in Fig. 5.

One circuit, that of the running lights for example, will serve to illustrate.

The current coming from the after switchboard goes by way of $a\,b\,c\,d\,e$. Then $b\,f$ and $d\,g$ will carry no current. If, on the contrary, the supply is from the forward switchboard, the current goes by $f\,b\,c\,d\,g$, the portions $a\,b$ and $d\,e$ carrying no current.

Projectors.—All the projectors have their circuits installed in the same way, the only difference being due to the locations of the mounts, the leads being as direct as possible. The variable resistances interposed permit of a current strength of either 45 or 64 ampères.

Signals.—The signal circuit comprises two outlets: one going to the foremast for 11 lanterns belonging to the Méritens system, the distinguishing lights and a Colomb lantern; the other to the mainmast for the position lights and a Colomb lantern.

The mast outlet is single as high as the spar deck; thence it goes to the mast and to the station in the spar deck for manipulating the signals, when it divides into three branches.

The first branch goes to the manipulator of the Méritens signal system. This manipulator is nothing novel, and the branches which it comprises, in order to connect with the lanterns, are arranged according to the usual methods and have a special cable.

The second branch goes to a Ducretet combination. This

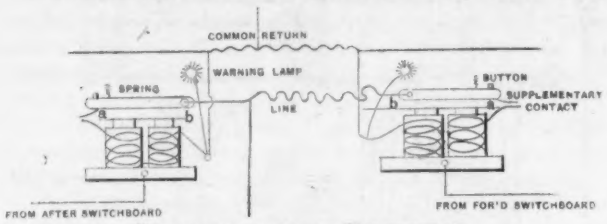


FIG. 3.—AUTOMATIC DISJUNCTOR.

branch has been left out, the contract not comprising the installation of distinguishing lights, the idea being to have this work done only when the ship is ordered to join a squadron.

CONDUCTORS RUNNING ON EACH SIDE.

		Area in sq. mm.
Port Side.		
Cable joining the switchboards		152.4
1. Return	Projector port.	33.4
2. Line	Projector port.	33.4
3. Return	Projector port.	33.4
4. Line	Projector forward.	33 4
5. Return	Projector forward.	17.78
6. Line	Reflectors.	17.78
7. Return for incandescent	Reflectors.	152.4
8. Battle line	Reflectors.	14.07
9. Day "	Reflectors.	38.19
10. Sea "	Reflectors.	17 78
11. Night "	Reflectors.	38 19

		Area in sq. mm.
Starboard Side.		
Cable joining the switchboards		152.4
1. Return	Projector starboard.	33.4
2 Line	Projector starboard.	33.4
3. Return	Projector starboard.	33.4
4. Line	Projector aft.	33 4
5. Return	Projector aft.	17.78
6. Line	Signals.	17.78
7. Return	Signals.	14.07
8. Line	Running lights.	14.07
9. Return for incandescent	Running lights.	152.4
10. Battle line.	Running lights.	14.07
11. Day "	Running lights.	38.19
12. Sea "	Running lights.	17.78
13. Night "	Running lights.	38.19

The third branch goes to a Colomb lantern, one of the wires having a fusible cut-out interposed, the other passing through a commutator button, used for manipulating the lantern.

The outlet on the mainmast in an ordinary branch circuit, which, on entering the mast, divides into two circuits, one going to the position lights, the other to the after Colomb lantern.

Running Lights.—The circuit of the running lights is only a single outlet on the foremast, which goes to the extinction detector, where it divides into four branches, for the masthead light, staylight and side lights.

The extinction detector is composed of four bobbins in direct circuit with each of the branches. The soft iron cores become magnetized as the current passes, and they attract their armatures. Should the current cease to pass, the armatures cease to be attracted, are drawn back by their springs and close the circuits of the "warning lamps" placed above the apparatus, which light up as soon as their corresponding active lamps have ceased to operate. At the same time a bell is rung. A resistance interposed in this circuit allows the dynamo current to be utilized for the bell as well as for the lamps.

The circuit of the running lights is broken near each switchboard by an automatic interrupter interposed in the line wire.

These automatic interrupters are electro-magnets whose armatures are used to open the circuit of the conductor, continuity being obtained where the larger armature is attracted by the cores which are there being traversed by the current. The cores are wound with fine wire, the two bobbins so wound being connected in series and the whole placed in shunt with the main circuit.

At the moment we move the commutator of one of the switchboards, if the large armature of the automatic interrupter in the same compartment has previously been pressed down, then the little tongue on the end of this armature having made contact with the wire of the electro-magnet the current passes in this wire, magnetizes the cores and the large armature remains attracted, thus keeping the main circuit closed until the current becomes nothing, when in obedience to the antagonistic spring the armature is repelled and the circuit thereby broken.

The current will flow in this circuit only as long as the warning lamp which is in shunt beyond the disjunctor is not lighted, on account of being short circuited.

The disjunctors or interrupters automatically break communication when the machine which feeds the secondary circuit is stopped, or when we manœuvre the commutator on the switchboard.

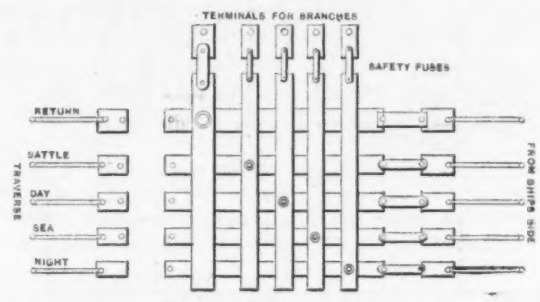


FIG. 4.—PERMUTATOR.

It is necessary then to manœuvre the armature of the disjunctor a second time in order to send the current from any other machine through the same circuit. These two motions serve the purpose of preventing one from inadvertently launching into a dynamo that is stopped the current from a machine in action.

Reflectors.—The reflectors have their circuits provided with two automatic interrupters, like the circuit for the running lights. Two outlets near each mast lead the current to two watertight receptacles, to which portable cables 50 metres long can be connected, to allow of the reflectors being placed on each side of the mast or outside the hull, as may be convenient for carrying on work.

These reflectors, two in number, are each composed of a conical lamp shade with a large opening, carrying in a wreath at its centre seven incandescent lamps, each of 50 candles. The dispositions of the circuits permit of placing the reflectors forward or aft, to starboard or port, as may be desired.

All the circuits are protected:

The projector circuits by lead safety fuses in the line wires at the switchboard.

The running light circuits, in addition to the safety fuses at the switchboard, by four cut-outs, one placed in each of the branch wires at its own extinction detector.

The signal circuits by safety fuses at the switchboard, by group cut-outs for the Méritens signals and the distinguishing lights and lamp cut-outs for the two column lanterns and position lights.

The reflectors have their safety fuses at the switchboard and especial cut-outs on each of the four mast outlets.

Interior Lighting.—We have already seen that among

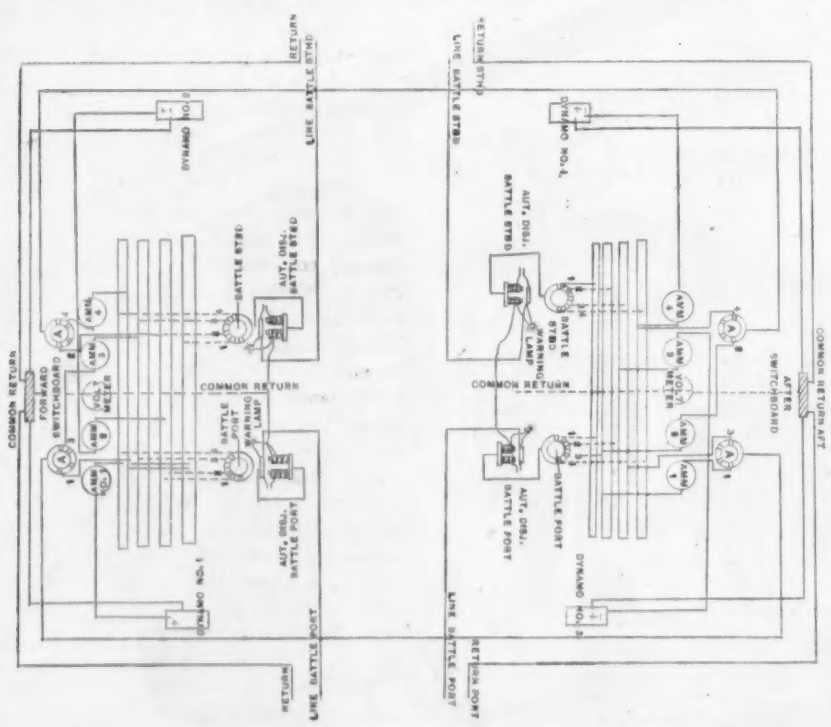


FIG. 1.—DISPOSITION OF THE AUTOMATIC DISJUNCTORS.

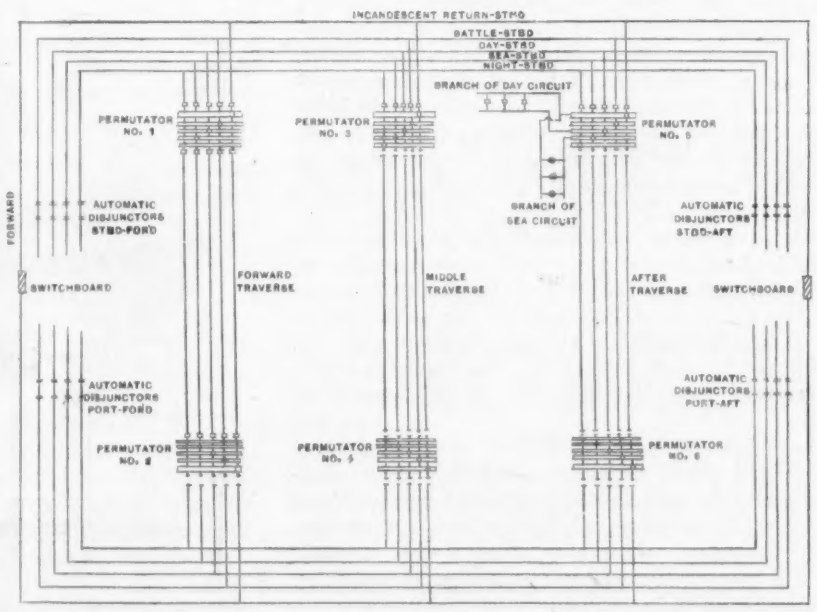


FIG. 5.—SECONDARY CONDUCTORS AND TRAVERSES.

*Taken from the "Revue Maritime et Coloniale."

the conductors coming from each switchboard there were on each side four, viz., battle, day, sea, night and a common return for these four, that is to say, a common incandescent return.

Like the running lights and the reflectors, each of the line wires is interrupted near the switchboard by an automatic disjunctor exactly like the one previously described. There are then near each switchboard 10 disjunctors.

Fig. 1 gives the disposition of the automatic disjunctors for the two battle circuits, starboard and port, the other being disposed in a similar manner.

The conductors going from one switchboard to the other and the common returns which are joined forward and aft, each carry three junctions, one near the forward switchboard abaft the automatic disjunctors in the forward dynamo compartment. The conductors thus joined to them go to two permutators (Nos. 1 and 2) placed symmetrically with the midship line of the vessel, in the compartment immediately abaft that of the forward dynamos.

These permutators are composed of bronze strips, placed in two parallel planes. The horizontal ones receive the ends of the conductors on one side and on the other they are joined to conductors of the same diameter which lead to a permutator symmetrical with the former and constitute what is called the forward traverse (Fig. 5).

Over the five horizontal strips corresponding to the five conductors on the side (four line and one common return) and about one centimetre in front of them are placed five vertical strips of the same width. Each of these vertical strips is joined as shown in Fig. 4 to one of the horizontal strips by a bronze screw.

It is the upper end of the vertical strips to which are connected the different branch wires. These strips each carry lead safety fuses to protect the branch wires emanating from them. All the permutators are fixed on slate bases.

The conductors connected at the middle junctions lead into the central pumping compartment to permutators Nos. 3 and 4 that connect the middle traverse. Those from

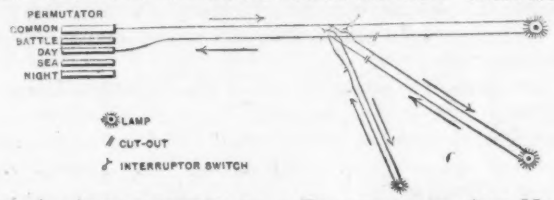


FIG. 6.—ARRANGEMENT OF A BRANCH FROM ONE MAIN CIRCUIT.

the after junctions are led into the compartment immediately above the after dynamo room and go to permutators Nos. 5 and 6 connecting the after traverse.

The disposition of this network can be seen from Fig. 5. There are represented the traverses without taking any account of the necessary installations according to the arrangement of the compartments. It is easy to show, however, by this scheme, many connections that can be made. The figure represents the starboard permutators joined to the conductors running along the starboard waist; those on the port side, on the contrary, are insulated completely from the port conductors, permutator No. 2 being joined by the forward traverse to permutator No. 1.

Under these conditions the distribution can only be made through the permutators Nos. 1, 2, 3 and 5 and only through the starboard feeders, the principle being that, everything being in good condition, the traverses will not operate, they being insulated from all the permutators, the latter being simply joined to the conductors on the same side as themselves.

It is only in case of damage to the secondary circuits that it would be necessary to connect the traverses.*

The sizes of the conductors are such that they can effect the distribution to six commutators, and consequently supply all the interior lighting with the circuits on one side.

It will be understood that the fall of potential is far from being the same to all these permutators. It varies with their distance from the switchboard in use and with the manner of distribution. In the normal case of feeding the permutators from both sides, the drop varies from .25 volt at the nearest one to the switchboard, to 1.5 volts for the farthest of the three; while when the six permutators take the current from one side only, the fall of potential varies from .7 volt for that nearest the switchboard, to 3 volts for that farthest away of the six.

(These values are only the mean, the losses not being equal on all the circuits.)

Fig. 1 merely shows how easy it is to send the current from any one of the dynamos to either switchboard, thence to one of the incandescent circuits by way of the permutators which are used to distribute the current through the branches.

Branch Circuits.—The branch circuits, varying in number for each permutator, are far from being all alike. Without entering into a description of all, we will content ourselves by taking as an example one of each kind that has been adopted to meet the local conditions:

* If one machine only is feeding into all the permutators there is no inconvenience in having everything connected, the three bridges formed by the traverses being completely closed.

1. The simplest of all, as for instance, a lamp connected near the terminals of the permutator, such as those in the pumping compartment to starboard of the conning tower.

2. A branch from *one* of the main circuits (there are two only of this kind). This arrangement is shown in feeding two lamps on the port side of the after-pumping compartment and one lamp in the lower storeroom. These three lamps are on the "day" circuit and disposed as represented in Fig. 6.

3. Branches from *two* circuits. This kind is one of the most scattered, and is sometimes combined into an arrangement as shown at *A* in Fig. 7. In this type are included all the branches that run above the protective deck for lighting the guns and spar deck, the branches for the storerooms and the forward part of the ship under the protective deck, compartments of the orlop deck above the boilers, engine room (middle after), and the starboard after compartments.

4. Branches from *three* circuits. This kind of an arrangement is adopted for the most important circuits and permits of the branches being very complex, such as in the vicinity of the boilers and engines.

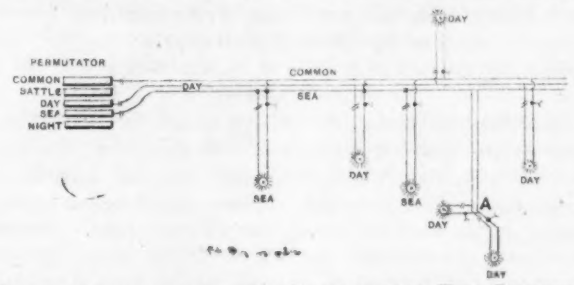


FIG. 7.—ARRANGEMENT OF A BRANCH FROM TWO CIRCUITS.

We will take, for example, the groups in the forward engine room, which are the most complicated. This disposition has been adopted on account of the particular conditions that have presented themselves. It is sought to avoid the difficulties which are presented when we attempt to run important conductors in the lower part of the engine rooms. The conductors are run along the upper part of the bulkheads, being placed under the best conditions for limiting as much as possible the number of lamps put "hors de combat" due to occasional damage.

In this type of circuit, each wire leaving the permutator carries a cut-out proportioned to the intensity of the normal current; each time that a new branch is taken off, on the path of the conductors emanating directly from the permutators, a group cut-out is placed on the common return. Finally, before the introduction of the wires into the covering which constitutes the mechanical protection for the branches going to the lamps, there is again placed a cut-out. The cut-outs for the lamps are in the line wires, the cut-outs in the common returns being automatic interrupters and of such a nature as to accomplish the complete independence of each lamp of the system. This complete protection permits not only of having a much greater security during the operation of the plant, but also on account of the accessibility of the cut-outs one can at a moment's notice quickly insulate any part of the network without interrupting the working of the other parts. This arrangement allows of repairing, during the preliminary trials, a circuit of the third class, where many of the lamps have their wires of the same polarity taken off from two different circuits, and this without stopping the operation of the other circuits coming from the same permutator.

The lamps in the turrets have their branches taken off below the protective deck and lead up from the bottom of the hydraulic loading tube in the hold. This tube follows the movement of rotation of the turret and consequently it is necessary to lead the conductors as near its axis as possible. The conductors could not be run exactly up the axis on account of the valve which admits water to the interior of the loading tube, and it was not desirable to employ movable contacts, which are always a source of anxiety, especially in the vicinity of water pipes under pressure, which are liable to leak; therefore it is necessary to allow a short length of flexible cable where the conductors enter the tube to permit of the horizontal displacement of the point of entrance about the axis. Notwithstanding all the care taken, these branches are particularly exposed and double pole cut-outs are used at the origin of the branch.

Circuits.	Permutator No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Battle	5	5	5	6	5	8	34
Day	17	15	22	20	22	27	123
Sea	8	7	12	12	7	8	54
Night	13	14	14	13	32	35	121
Total	43	41	53	51	66	78	332

CURRENT REQUIRED FOR THE DIFFERENT CIRCUITS.
(70 volts at the switchboard.)

Circuits.	Ampères.	Circuits.	Ampères.
Battle	19	Reflectors	42
Day	69	Signals (maximum)	32
Sea	30	Running lights	7
Night	68	Four projectors	(65 or 45 at will.)

Now that we have observed all the features of the installation of the Marceau, we can combine the whole system in order to get a general idea of the dispositions which it involves. The successive figures interposed thus far in this article show the theoretical difficulties that have been encountered in the arrangement of this installation. All

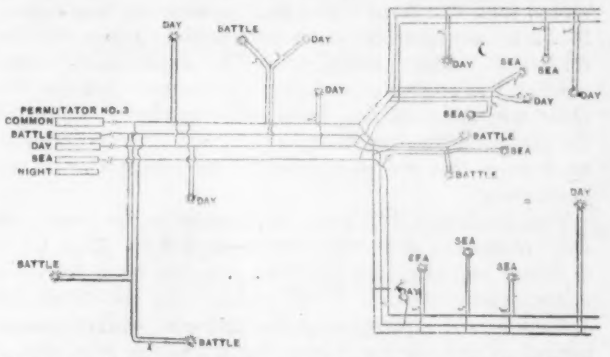


FIG. 8.—ARRANGEMENT OF BRANCHES FROM THREE CIRCUITS.

these figures considered separately give but a small idea of the massive complication that has been brought about on board this vessel for attaining in practice the theoretical ideas which have conduced to the adoption of this system.

The exact installation of the after switchboard and automatic disjunctors (interrupters) depending on it (Fig. 9), serve better than a long discourse to indicate the complications arrived at in order to meet the exigencies of the situation. The same thing applies to other parts of the installation. It must be remembered, however, that these complicated arrangements were installed quite recently, the original installation being quite simple, but added to later.

Looking at it in this way, one is constrained by the force of things to be reconciled to the situation (switchboards, automatic disjunctors and permutators), convenient enough perhaps, but only adopted for want of something better. We must look to see that in the plans of future vessels we are not contented with merely providing a place for the dynamos, but also all the apparatus necessary to be operated by electricity. This agent is extending itself every day on board war ships, and for the good operation of all the organs which depend on it we must rely greatly on details. With locations properly studied out, we can greatly simplify the network, and in this way gain not only in material, but in efficiency, inasmuch as the losses can be reduced.

In the figure representing the after switchboard and disjunctors, we have reduced the apparatus to their simplest form, the outlines only; one can then judge of the confused mass of conductors and the difficulties which would be encountered in seeking for faults in the midst of this confusion.

The table above gives a repetition of the lamps by circuits and by permutators.

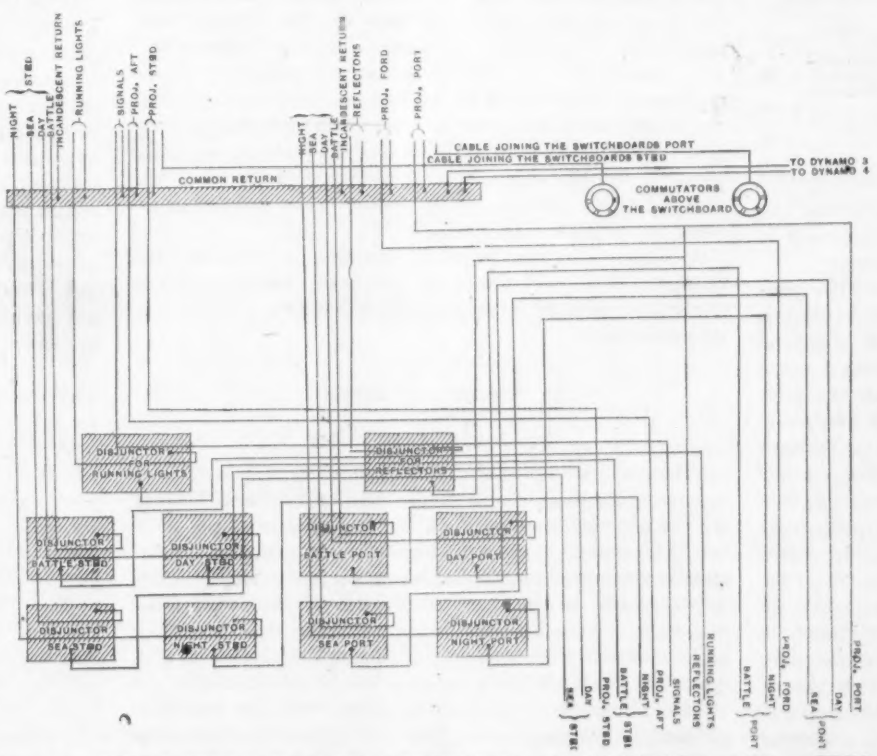


FIG. 9.—DISPOSITION OF THE AUTOMATIC DISJUNCTORS AND AFTER SWITCHBOARD.

Boston Electric Club's Dinner.

The Boston Electric Club held its election and dinner at the Parker House, Monday evening of last week. Mr. H. B. Cram was elected president for the ensuing year and Mr. R. F. Ross secretary. The Board of Directors was reduced from twenty to seven. The new by-laws were adopted and resolutions were passed to give up the permanent rooms of the club, but to continue the organization by having club dinners at stated times, when prominent men in the electrical business would be invited to be present, and arrangements made, if possible, for papers to be read which would be of interest to the members. About forty people sat down to the banquet, after which the club was delightfully entertained by addresses by Prof. Thomson, Prof. Cross, Prof. Dolbear

George Cutter, W. J. Denver and others. A very enjoyable time was had by all.

The Dubuque Storage Battery Street Railway.

THE ELECTRICAL WORLD of July 25, 1891, contained a full description of the storage battery plant operated by the Dubuque Street Railway Company, payment for which has been declined on the ground that the system was not a success. Thus, The Accumulator Company, of Philadelphia, has been compelled to resort to legal measures to secure payment of notes, aggregating $50,000 and long past due.

The original contract entered into by the street railway company with The Accumulator Company covered only the electrical equipment of the cars and the electrical charging plant, and payments were to be made part on delivery and balance "thirty days after the plant was placed in successful operation." A special contract, entirely separate from the contract for equipment, guaranteed that for a period of four years the cost to the railway company for maintenance of the battery should not exceed a given named sum per cell per annum, provided the cells were used in accordance with instructions given.

The first payment was made with notes that were not met when due, and, with the permission of The Accumulator Company, were renewed. These notes and the balance due still remain unpaid. The railway company offered to settle the entire contract with new notes, but The Accumulator Company declined to accept them.

Up to this time the street railway company had constantly maintained to the public, both by letter and in interviews, that the plant was a success and was economical. But after a reported failure to negotiate bonds and the refusal of further credit from The Accumulator Company, it was offered as an excuse for non-payment that the plant was not a success, basing this excuse on the life of the positive plates not being as long as claimed, although no term of life was mentioned in the contract or in the guarantee.

Nine handsome Brill cars were secured by the street railway company, and were each equipped by The Accumulator Company, with two 15-h. p. double reduction Edco motors, and two sets of 80 cells each of type "23 M," of The Accumulator company's secondary batteries, while Griscom generators and the usual charging apparatus were placed in the power house. The street railway company secured two poorly set boilers and a second hand compound condensing engine that would not govern, and often had to be taken apart. A few months later this was replaced by an excellent Sioux City Corliss engine.

The displacing of the antiquated vehicles by the new Brill cars and the increased speed secured so pleased the citizens of Dubuque that within a few weeks the daily average income of the company was reported to have been doubled, while a careful examination of the expense accounts shows that during a period of seven months, ending Dec. 25, the cost of motive power for the cars per car mile was seven and a quarter cents made up as follows:

	Cents per car mile.
Power plant, including labor, coal, oil, waste, dynamo brushes repairs, lamps, etc.	1.801
Battery—Renewal of positive plates and other battery material including all freights and boxing, on new and old material.	3.509
Labor connected with batteries, including shifters, cleaners, watchmen and electricians.	1.780
Repairs to electrical machinery excluding repairs due to collisions.	0.134
Total.	7.224

Had reasonable care been observed in handling the electrical equipment the item of expense for renewal of positive plates would have been materially reduced.

Only six cars were maintained in service, and the positive plates from the unused cars were used in replacing those worn out in service, and only when it began to appear probable that the company would be left without motive power were new plates ordered, for which cash was paid on delivery. This delay in securing renewals shortened the life of the positive plates, as the maximum output was constantly required from the overloaded limited number of efficient plates. And this uncalled for overload was further increased by the apparent lack of discipline that was clearly indicated in an expressed indifference to orders relative to the proper handling of the motive power. For instance the cars were supposed to be operated on a 10-minute schedule, yet complaints were made that three or four cars had been found bunched at one end of the line, and often cars would follow within two or three blocks of each other. And this was due to no fault in the electrical equipment, but to the absence of recognition of authority and lack of suitable supervision. And even though the patrons did patiently or impatiently await the coming car, still the income of the line was doubled, and could have been further increased under proper management.

It is not claimed that this uneconomical operation of the cars was due to any deliberate intention to prove that the system had no commercial value and thus relieve the street car company from paying what appears to be rightly due, but was caused by selecting motor-men who were no more qualified to properly operate an electric car than to drive a valuable race horse, and who were quite likely to apply the electric brake at street crossings, although it was repeatedly and clearly explained that this device was for use only in cases of extreme urgency, as, for instance, to avoid a collision, the effect on the motor being necessarily severe. Again, cars were run out of the barns before having the discharged battery replaced with freshly charged cells, and cars were often run a far greater number of miles before exchanging cells than was ever intended. Often the motors would be placed in parallel to secure increased speed or to race with the trolley cars, where such speed was entirely unnecessary and obtained only by double the consumption of current necessary to maintain the regulation speed.

For months after the cars went into operation no provision was made for handling cells, and for weeks there was not even a hole in the ground to facilitate the inspection of gearing at the close of the day. No provision had been made for repairs to the machinery nor a machinist engaged, while an old snow plow is depended on to keep the track clean, although the surface of the broken stone roadway is several inches above the track. And yet the street railway company insisted that the system was not a success!

How Electric Signals on Steam Railroads Are Acted on by Electric Railways.

BY J. H. AITKIN.

Since the completion of the Allentown & Bethlehem (Pa.) electric railway, the electric train signals on this section of the Lehigh Valley Railroad Company have been frequently and often entirely thrown out of action by the heavy earth currents from the electric road. These troubles began with the running of the first cars. Before the opening of the road in July no trouble from a similar source had ever been experienced.

The signals mentioned consist of a track instrument containing a mechanical circuit opener with sliding spring contacts. One contact is grounded by a wire to the rail, which is used is a return to battery. The other contact connects to an overhead line. In its normal state a closed circuit is maintained through the relay, line, instrument, track and battery. A train passing moves the lever, opens the contact and breaks the circuit. The armature drops and brings in play a local circuit and bell.

Operators began reporting the bells as ringing continually when no train was passing, or not ringing when trains had gone over. Examination proved the instruments in order and the batteries strong, and that at night, after 12 P. M., the instruments worked all right. On disconnecting the battery from the main circuit and placing a galvanometer in its place, a deflection of 15 to 30 degrees was obtained. This earth current was sufficient in itself to hold up the armature, which it often did for an hour or more. The approach of an electric car invariably affected the circuit, either causing the armature to drop or hold too strong to signal a coming train.

At Allentown, where the electric road crosses the railroad tracks, the disturbance was greatest, the distance to the nearest instrument being not over one-quarter of a mile. One mile below this, and over a mile from the electric road, a similar condition resulted. An equal distance west the same cause was found. At Bethlehem two instruments, one half mile from the road, were similarly acted on. Heavy and light days on the electric road showed in a corresponding manner on our instruments. In some cases it was found reversing the batteries removed the trouble, in others more batteries were necessary. But singularly, with batteries on different instruments not one mile apart, one would require zinc to ground, the other copper. In two cases it was necessary to increase the strength to six cells of gravity battery, and even then reverse the ground connections.

A return overhead wire is the best solution to the problem. The rail return is still used; but by acting as above described no further trouble has been experienced in this direction.

Teleikonography.

BY JAMES MARK BARR.

When will we agree that there is evolution in inventions to a complete degree? A statue in Central Park, bearing the inscription "Samuel F. B. Morse, Inventor of the Electric Telegraph," is passed daily by thousands whose fixed creed concerning telegraphic invention is expressed entire by the words on the base of the statue. But with those who have ever had the misfortune to read old "records" and "claims" with a view to acquiring definite ideas with regard to those who may or may not have invented the electric telegraph, it is quite different. We are forced to see that as the age for the birth of a new application in science comes on, many minds begin to work in similar channels upon those things for which the time is ripe.

In THE ELECTRICAL WORLD of Jan. 16, 1892, Mr. A. P. Trotter has given an account of certain experiments of his relating to a system of "Pictorial Telegraphy." He mentions the alleged invention of Mr. N. A. Amstetz, of Cleveland, O., regarding whose work in the line of image transmission we have seen some startling newspaper accounts of late. The writer of this article together with a friend, having also given some attention to the subject, and finding that the results obtained and the general experiences of Mr. Totter are almost identical with his own, wishes to make a modest claim to certain parts of the invention as given in the article mentioned.

In July, 1889, I came across an old number of the *Scientific American* of the seventies, in which was a contribution by Mr. W. E. Sawyer, now deceased. The article was a lengthy description of a scheme for transmitting visual images. The principle of the invention was unique, but impracticable beyond all hope, as the author admitted. There is no need to explain the system here beyond saying that upon a disc which was to show the received image there were many hundreds of microscopical loops of filamentary carbon. One of these tiny loops was always in circuit as the apparatus worked, and the position of the glowing loop was always in the same relative position to a corresponding point on the image at the transmitting station—the reverse of a Caselli foil drawing. A spiral trailing motion was to be used, if I remember rightly, and the image was to be traced and retraced within such an interval of time as would produce by light effect from the carbon loop disc an image to be observed as the apparatus was in operation. It struck me that perhaps a photographic method of sending images might be contrived, and together with Mr. Francis P. Mann, of the Westinghouse Electric Company, I set out to experiment. We worked out a system wherein was to be used the well known selenium cell method of transmission on one end, and for the other station we devised several photographic methods of receiving. The first photographic receiving method consisted of screening at intervals a point of light which moved synchronously over the surface of a photographic plate, and for tone work in "diaphragming" a light point as it passed over the receiving plate.

Another method included a tone relay consisting of as many circuit making magnets for throwing in more or less current as there were to be tone gradations. But such schemes can only be worked as laboratory experiments. The problem of synchronism comes in, to say nothing of the uncertainties of selenium cells. After many trying days with sand baths, ribbon copper which was hard to insulate, and expensive selenium powder which had an aggravating way of going up in vapor, we found out how impossible it was to make a cell which would remain constant in its changes for a practicable, or I might almost say appreciable, time.

Mr. Henry F. Albright, now of the Thomson-Houston company, had in the meantime suggested a method of receiving upon metal or other material of less hardness, by means of engraving, as mentioned by Mr. Trotter in his article referred to above. I have most of the drawings made at the time, and also a note-book containing records of certain experiments which were made between October, 1889, and February, 1890. Nearly all are dated and witnessed.

But we found the selenium method of transmission impracticable, and obtaining with the Caselli foil unsatisfactory results, as experienced by Mr. Trotter, we devised a method of transmitting coarse lined newspaper cuts, wherein a point actuating a contact breaker was made to pass over the "high and low cut" itself. This gave rather fair results, and was almost as positive in its action as the old many-wire type system to be seen in records of Caselli's work. However, a carefully made drawing upon metal foil answers quite well if one does not care about trouble.

As to the receiving instrument, we had two forms, one wherein by means of a feed screw carrying the engraving point or tool over a rotating disc, the image was formed by a close-lying spiral line. But this would not give the recording point a chance to "start fair" at intervals, as Mr. Trotter puts it, with the transmitting point. So I devised an apparatus which was to carry the plate in much the same way as is used in the ordinary machine planers. But the return was to be utilized at the same speed as in the reverse direction. We have many sketches of various forms of engraving points and one wherein "60 degrees" is specified. In October or November, 1889, we made sketches of a receiving apparatus in which we gave details of a vibrating tool. I have one of the drawings before me now. In this we showed an extra solenoid excited by a vibrating local current. In another sketch which I made in Chicago on Jan. 8, 1890, I drew the details of a drill which was to be used in exactly the same way as mentioned by Mr. Trotter. Mr. Albright also proposed to punch a series of dots upon the receiving plate. In Pittsburgh, between Dec. 9, 1889, and Jan. 8, 1890, Messrs. Mann and Albright made a tool in much the same way as mentioned in THE ELECTRICAL WORLD, except that plaster of paris and wax were used. We had in mind many sample blocks engraved with convincing images which we were to place before the eyes of those not sanguine, but it is needless to say that no results were obtained which would fill one's heart with hope.

I remember afterward being told that "Caselli cuts looked like under water." I faintly suggested cutting the lines at an angle. "It will look like a rain storm." And to have the tint lines perpendicular to the horizon makes a particularly distressing sight.

The last thing I saw of a wax engraving which I kept was when the servant was waxing her irons. I turned the block over and sighed slightly. As to the model, I am using the main solenoid as a paper weight, as the terminal wires are broken off short. We never filed a provisional specification, and if we had, only "Abandoned" could appear in the *Official Gazette*.

Lately Mr. Edward N. Everitt, of the Southern New England Telephone Company, and myself took the subject of Teleikonography up again, but we have decided to wait until there is a demand and a method.

Secondary Batteries.—III.*

BY G. H. ROBERTSON.

THE CHEMISTRY OF THE ACID.

Although so many different modes of manufacture and preliminary treatment have been resorted to, all the batteries, so far as I am aware, which depend for their action on the couple formed between lead and lead peroxide in dilute sulphuric acid, exhibit the characteristic peculiarities noticed by Planté in his cell—namely, the high initial E. M. F. of a freshly charged cell; the fall of E. M. F. on breaking the charging circuit, with corresponding rise on breaking the discharging circuit; the very rapid fall toward the end of discharge which occurs earlier, the more rapid the discharge is, and is not due to the exhaustion of the active material, as after a rest a fresh discharge can be obtained.

As the defects—namely, sulphating and buckling—which have retarded the introduction of reversible lead batteries are also common to the two types, it appeared possible that they were due to the same causes which produced the variations in E. M. F.; therefore, as the work of Dr. Oliver Lodge† in 1883 and of Miesel‡ in 1888 had shown that the causes of the variation must be sought either on the lead plate, or in the acid next it, and the chemistry of the plates afforded no explanation,§ I last year, with Dr. Armstrong's advice and assistance, undertook the investigations of the reactions occurring in the acid.

Planté had considered that the peculiarities in E. M. F. were due to the formation of peroxides in the acid, and showed that the conditions existing in a cell were favorable to their production, since in voltameters with lead electrodes they were formed in greater quantity than in those with platinum. He also noticed that, immediately on the cessation of the charging current, there was often a small evolution of gas from the peroxide plate; this evolution he ascribed to local action between the peroxide and the subjacent lead.

Commenting on this in their little book, "The Chemistry of Secondary Batteries," Messrs. Gladstone and Tribe point out that the gas is oxygen and cannot be due to local action, since the gas was evolved whether the peroxide was removed from the supporting plate or not. The application of heat increased the evolution of gas, and the gas was oxygen. Testing the acid between the plates, they always found traces of something which decolorized permanganate, and might, therefore, be hydrogen dioxide or ozone.

Although a very large amount of work has been done on the electrolysis of sulphuric acid solutions, and the general character of the change in the nature of the products formed as the strength of the solution is varied is well understood, the only references I was able to find to any examination of the acid in a battery were those just given; and, therefore, I have ventured to bring the results of my own experiments before this society, not because I consider them a final solution of the difficult problem of the chemistry of the cell, but because I hope that the study of the changes occurring in the electrolyte may help to elucidate some points which are at present obscure.

And now it may be well to refer briefly to the work which has been done in sulphuric acid.

In 1878 Berthelot* discovered persulphuric acid ($H_2S_2O_8$), and brought forward evidence to prove that it is the primary product of the electrolysis of sulphuric acid solutions, and that the hydrogen dioxide—which from Faraday's time has been well known to be present in sulphuric acid after electrolysis—is really due to the action of this body on the acid. The products of electrolysis vary with the strength of the acid, 40 per cent. acid (density 1.300) yielding practically no hydrogen dioxide, while below and above that strength it is present in varying proportions. High current density and an electro-negative condition of the electrodes favor their formation.† Persulphuric acid is an unstable body, and begins to decompose as soon as the current which has given rise to it is stopped, and its decomposition is accompanied by the formation of hydrogen dioxide, unless the sulphuric acid is too dilute. Hydrogen dioxide is also unstable when concentrated, but a weak sulphuric acid solution of it is comparatively stable, and the stability increases the less hydrogen dioxide it contains; therefore this body is found in estimable quantities long after the persulphuric acid which gave rise to it has disappeared. Persulphuric acid is at once decomposed by spongy metal, such as platinum black, by heat with evolution of oxygen‡, and resembles hydrogen dioxide in these reactions, and in releasing iodine from potassium iodide, but, unlike it, has no action on permanganate of potassium or peroxide of lead. The effect of electrolyzing a sulphuric acid solution of hydrogen dioxide is simply to increase the rate of decomposition occurring spontaneously if a weak E. M. F. is used§; but on increasing the E. M. F., though the rate of decomposition is increased, a little persulphuric acid is re-formed.

Subsequent workers have in the main confirmed Berthelot's conclusions. To the oxidizing oxygen in the products of the electrolysis of sulphuric acid Berthelot gave the name of "active oxygen," and as they pass from one into the other, and for most purposes connected with a battery it is not necessary to discriminate between them, I have retained it.

EXPERIMENTS AT THE GENERAL POST OFFICE.

That the nature of the electrolyte affected the behavior of the cell was evident from information received from Mr. Barber-Starkey with respect to the effect of the addition of sodium carbonate; and it seemed possible that the different behavior of cells containing this substance was due to its catalytic action on hydrogen dioxide, which is known to be exceedingly unstable in the presence of a trace of alkali; and hence a comparative study of the reactions occurring in cells containing ordinary dilute sulphuric acid, and in those which have been treated on Mr. Barber-Starkey's plan, seemed likely to elucidate the causes of the sulphating during rest, and the high initial E. M. F.—the two features most affected by his treatment.

Mr. Preece most kindly aided the investigation by allowing experiments to be carried out at the General Post Office, where one-half of the secondary cells contain one per cent. of sodium sulphate, and the other half ordinary dilute acid, density 1.180. He also put at my disposal the record of the behavior of the cells, and they proved that there was much less sulphating with sodium sulphate, as shown by the density of the acid never falling to the same extent as the plain cells. The following readings taken from short-circuited cells with badly broken plates illustrate this. In two cells containing ordinary dilute acid the density of the electrolyte had fallen to 1.100, while, according to the last readings, before the short circuit occurred, it had been 1.170 and 1.180 respectively; while in the two sodium sulphate cells the density had only fallen to 1.180 from 1.200 under similar circumstances.

There was strong evidence in favor of the hydrogen dioxide formed in the working of the cell being appreciable in quantity, since its sulphating was only due to local action between the support and the paste; there does not appear any reason why the addition of sodium sulphate should affect it.

Whenever the cells were tested they were always found to contain "active oxygen," which was due to the presence of persulphuric acid and peroxide of hydrogen in varying proportions. During charge persulphuric acid is the main constituent; during discharge the quantity of hydrogen dioxide gradually increases; while in a cell which has been at rest some there is very little except hydrogen dioxide to be found.

In addition to the tests made on the cells in the electric light and telegraph batteries, I studied the formation of the "active oxygen" during charge and discharge on some cells which were kindly set apart for my special use. The "active oxygen" forms at once on the passage of the current, decreases slightly, and then increases to a little above its first value. Starting either charge or discharge always causes an initial increase, except in the case of cells which have been long idle, when there is a diminu-

Accumulator.	Type.	Material of Cell. Lead plates and H_2SO_4, or otherwise.	Capacity in ampère hours.	Capacity in watt hours.	Charging current.	Max discharging current.	No. of plates. +	No. of plates. −	Thickness of plates in inches +	Thickness of plates in inches −	Total area of plates (sq. ft.)	Ampères per sq. ft. Total plate area discharge.	Approximate external dimensions of cell. Length.	Breadth.	Height.	Height over all.	Total weight of cell (pounds).	Ampère hours per pound of total weight.	Watt hours per pound of total weight.	Efficiency (Watt).
Reynier.	—	Lead and lead peroxide in sulphuric acid.	30	740	—	6 ampères.	—	—	—	—	—	—	12 in.	12 in.	—	12 in.	100	0.3	7.4	—
E. P. S.. (Electric Power Storage Co.)	1888 L	Lead grids pasted. H_2SO_4.	130	247	10 to 13	13	3	4	—	—	—	—	5¾ in.	13¾ in.	18¼ in.	20½ in	74	1.7	3.3	—
	1890 K	Ribbed lead plates pasted. H_2SO_4	—	—	15 to 25	25	3	4	—	—	—	—	5½ in.	11⅛ in.	13⅛ in.	16½ in.	81	—	—	—
Oerlikon	B	Hard lead grid pastes made of red lead and litharge.	50	95	6	10	4	5	0.2	0.2	1.9	5	7.8 in.	9.2 in.	8.77 in.	—	39.6	1.25	2.4	—
	E		260	494	30	48	5	6	0.2	0.2	8.9	5.4	9 in.	14.4 in	16 4 in	—	156.2	1.6	3.1	—
	F		160	3?4	18	25	5	6	0.2	0.2	5.6	4.4	9.2 in.	11.7 in.	12.5 in.	—	96.8	1.6	3.1	—
	D		70	133	9	9	8	9	0 1	0.1	3.8	2.3	5 5 in.	6 8 in.	8.6 in.	—	26 4	2 6	5 0	—
"D. P.". (Drake & Gorham).	A	Pasted positives. Lead negatives dilute H_2SO_4	140	266	12	12	—	—	—	—	—	—	13⅛ in.	8 in.	12⅛ in.	—	65	2.1	4	—
	H		725	1,377	66	66	—	—	—	—	—	—	13⅛ in.	18 in.	12⅛ in.	—	240	3	5.7	—
Tommasi Multitubular.	—	Red lead and litharge in porous pots. Dilute sulphuric acid.	321	642	25 to 100 ampères.	18 to 30	9 tubes	9 rectangular	9.75-in. by 2 in. by ¾-in.	9¾ by 2 by ¾	—	—	6¾ in.	6¾ in.	10½ in	—	Total weight of the electrodes, 47.7 lbs.	Per pound of electrode, 6.7	—	80 percent.
Julien... (Consolidated Electric Storage Co.)	S. 17	Pasted plates	180	—	15	20	8	9	1-8	1-8	5.4	3.6	8 in.	7 in.	10 in.	—	42 lbs.	4.3	—	—
		Dilute sulphuric acid	180	—	15	20	8	9	1-8	1-8	5.4	3.6	7½ in.	5¾ in.	9 in.	—	37½ lbs.	4.8	—	—
Gadot...	1 A	Double grid containing pastelles made from oxides of lead. H_2SO_4	28	53.2	3.1 ampères.	52	2	3	—	—	—	—	7 in.	3¾ in.	—	13.6 in.	17.6	1.6	3	—
	10 E		1,063	2,019.7	116	193	11	12	—	—	—	—	21.6 in.	20 4 in.		26¾ in	792	1.4	2.66	—
Crompton-Howell.	No. 11	Lead plates and H_2SO_4	220	440	28	85	5	6	1-4	1-4	11	20 at 3 or 10 at 10	8½ in.	12½ in.	12 in.	14 in.	115	1 9	3.8	85 per cent. Current efficiency 93 to 95 per cent.
	17		340	680	42	135	8	9	1-4	1-4	17		13½ in.	12½ in.	12 in.	14 in.	182	1.9	3.8	
	21		420	840	52	170	10	11	1-4	1-4	21		16½ in.	12½ in.	12 in.	14 in.	220	1.9	3.8	
	31		620	1,2 0	78	25	15	16	1-4	1-4	31		29 in.	12½ in.	12 in.	14 in.	460	1.4	2.8	
	61		1,200	2,400	152	500	30	31	1-4	1 4	61		54½ in.	12½ in.	12 in.	14 in.	880	1 4	2 8	
Atlas.... (Société des Applications de l'Electricite)	No. 1	Blocks composed of plates made of oxides and salts of lead. H_2SO_4	150	$\frac{2+1.8}{2}$ 150 285		8	16 normal 10	10	10	0.4	0.4	—	—	7 in.	6.29 in.	inch. 12.57	inch. 13.75	Weight of plates = 17.63 lbs.; of acid = 6.6 lbs.; of the containing vessel is from 2.2 to 8.8 lbs.	9.6 per lb. of plates. 5.4 to 7 per lb. of total weight.	16.1 per lb. of plates 8.6 to 10.9 per lb. of total weight.	—
Roberts..	Modified Faure twin plate.	Lead alloy, H_2SO_4 combined with an alkaline solution.	75	162	15	Practically unlimited.	2	3	9-32	9-32	18 9-12	4	7½ in.	2½ in.	10 in.	12 in.	20	3.75	8.01	87 to 93 per cent. according to rate of discharge.
			150	325	25		4	5	9-32	9-32	33 9-12	4	7½ in.	5 in.	10 in.	12 in.	38	3.95	8.55	
			250	545	35		4	5	9-32	9-32	63 9-12	4	9½ in.	5 in.	12 in.	13½ in.	70	3.55	7.71	
			450	990	50		8	9	9-32	9-32	108 9-12	4 (about)	9½ in.	10 in.	12 in.	13½ in.	110	4.09	9.00	
Legay...	—	Plates made of lead wire rope formed by Planté's process.	194	361	20 ampères.	20? ampères	4	5	2-3	2-3	75	—	9 in.	9 in.	9 in.	11½ in.	65	3.07	5.6	—
Tudor...	VII.-A	Lead.....	240	456	18	24	—	—	1.3	1.3	—	—	—	—	—	—	112.2	2.1	—	—
	D	Lead peroxide in dilute sulphuric acid.	168	321	48	60	—	—	1.3	1.3	—	—	—	—	—	—	112 2	1.5	—	—

* Paper read before the Society of Arts, London. (Concluded.)
† Cantor lecture.
‡ "Monatschafte für Chemie," VIII., 713.
§ For references and a summary of the principal work done on the cell, see *The Electrician*, vol. XXVII., No. 682, p. 165; No. 692, p. 437.

* Berthelot (*Compt. Rend.*, 90, 269-275).
† Richarz (*Ann. Phys. Chem.* [2], 31, 912).
‡ Berthelot (*Bull Soc. Chim.*, 2, 34, 78-81).
§ Berthelot (*Compt. Rend.*, 95, 8-11).

tion due to the decomposition of the excess of hydrogen dioxide in the acid.

To test whether electrolyzed acid was able to reduce pure peroxide of lead, two equal lots of peroxide were taken by weighing one against the other, and put in two flasks. On to each, 100 centimetres of acid, from next the positive plate of a cell at full charge, was poured, and this caused the evolution of oxygen, which continued slowly for some days. At the end of a fortnight the amount of peroxide of lead in each sample was estimated, and it was found to have decreased from 97.4 to 93.94 and 94.04 per cent. respectively.

This appears to explain the well known deleterious effect of rest on a cell; for although persulphuric acid itself does not reduce peroxide of lead, it forms hydrogen dioxide on standing, which is capable either of oxidizing the lead plate to litharge, or of reducing the peroxide plate to the same substance. In each case the litharge is converted into sulphate by the sulphuric acid.

In an ordinary cell in good order the amount of "active oxygen" is small, varying in quantity from about 0.01 gramme to 0.02 gramme per litre; but this means that in a 45-pint cell (the size used at the Post Office) there was always sufficient to convert from 3.25 grammes to 7.5 grammes of peroxide of lead into sulphate or to undo the work of one to two ampère-hours' charge.

This is not a serious matter if the cells are kept working, as the peroxides are being continually broken up with each reversal of the current, but if the cells stand idle the plates get sulphated and the amount of "active oxygen" formed in the next passage of the current shows a marked increase.

The figures just given do not represent the total amount of "active oxygen," since the acid absorbed by the plates cannot be tested; but as the acid has more oxidizing power the nearer you get to whichever is the positive plate, except at the commencement of discharge, and the total quantity of "active oxygen" increases rapidly soon after breaking circuit, it seems fair to assume that this increase is due to diffusion from the plates of acid which has more oxidizing power than that in the body of the cell.

This increase is followed by a decrease, which is rapid at first, and then gradually gets very slow, and practically ceases while there is still a fair proportion of "active oxygen" left in the cell.

In the sodium sulphate cells the amount of the oxidizing agent was usually less than in the plain cells; and the amount of oxygen dioxide was always so, unless the battery had been at rest for some time, when the conditions were occasionally found to be reversed. This, I suppose, is due to the proportion of "active oxygen" in the form of hydrogen dioxide, at the moment of stopping the current, being greater in the plain than in the sodium sulphate cells, while the latter contain more persulphuric acid. In both cells the hydrogen dioxide present at the time of stopping the current will be reduced on the plates, sulphating the surface, and more or less screening them from further action; but as the sodium sulphate cell contains more persulphuric acid, the subsequent formation of hydrogen dioxide will be greater in it than in the plain cell. As far as I could discover, sodium sulphate has little or no action on the acid unless it is added during electrolysis, or to acid which has just been taken from a cell through which a current is passing.

The Pink Color of the Acid.—It has often been noticed that during charge, particularly with new cells, a pink color starts from the peroxide plates, and gradually spreads over toward the lead plates, fading away, however, before reaching them. This pink color was referred to by Mr. Crompton at a meeting of the Institute of Electrical Engineers on Dec. 13, 1890, and its origin gave rise to some discussion; so as the acid in many of the cells at the Post Office was pink, I tested it by concentrating it down, neutralizing with sodium carbonate, and then igniting on platinum foil, and always got the characteristic green of manganese.

However, lest the manganese should have come from some other source than the pink acid, I compared the absorption spectrum of the acid with that of a solution of potassium permanganate of the same shade of pink, and found they both gave the characteristic bands in the green, Fig. 14. I also found that, using two strips of platinum as electrodes in a solution of manganous sulphate, or any two strips of lead in dilute acid, gave the same color and the same absorption bands, provided the electrodes were sufficiently far apart to prevent reduction by the hydrogen evolved by the negative. This result was important, for it is well known that the pink color disappears from the acid in a short time if it is taken from the cell, and as persulphuric acid has no action on permanganate, but hydrogen dioxide decolorizes it, this disappearance of the color shows that the latter is formed.

The Effect of Hydrogen Dioxide on the E. M. F. of a Cell.—The presence of hydrogen dioxide having been thus proved, both directly and indirectly, its effect on the E. M. F. of the cell was tested. This was done by using strips of lead packed tight into small porous pots, with peroxide of lead to represent the peroxide plates, and using plain strips as the lead plates. A solution of pure sulphuric acid, density 1.180, was used as the electrolyte. The E. M. F. of the couple was taken by the deflection method, and then a drop or two of hydrogen dioxide was added to the acid, which produced a great diminution, or even reversal, of the E. M. F.

The effect of introducing hydrogen dioxide into the body of the peroxide paste was also tried, with a view of reproducing, if possible, the conditions of a cell which is started discharging directly the charge is completed, and in which the "active oxygen" would be accumulated at the positive plate, leaving the lead plate free, and I found that there was a slight increase in E. M. F.

Thus the variations in E. M. F. appear to depend on which plate hydrogen dioxide is formed at. When present at the peroxide plate it causes a rise, but when diffused through the acid and present at the lead plate it causes a lowering of the E. M. F.; and the rise in E. M. F., sometimes noticed on starting the discharge of a cell which has been at rest (mentioned in Prof. Ayrton's paper, J. I. E. E., 1890, p. 572), is probably due to the electrolysis and decomposition of hydrogen dioxide, for, in a cell which has been long idle, practically the whole of the "active oxygen" is due to this body.

CONCLUSIONS.

From the same faults appearing in batteries of such different construction, and judging also from the results of the experiments recorded in this paper, it would appear that the troubles occurring in batteries are due rather to causes arising in the working than in the manufacture. What is required is some substance which can be added to the acid to check the formation of the oxidized bodies in it, which cause sulphating without at the same time injuring the plates in other ways.

Nearly all the "forming" baths which have been introduced are baths in which hydrogen dioxide would be broken up as soon as formed, and perhaps in some modification of them the electrolyte of the future will be found; though, since the products of the electrolysis of sulphuric acid vary with the strength of the acid and the current density, no hard and fast rule can be laid down for the treatment of cells.

In cells containing acid below density 1.200, in which the proportion of "active oxygen" existing as hydrogen dioxide is high, the addition of 1 per cent. of sodium sulphate, or similar substance, is likely to prove beneficial, particularly if the work of the cells is intermittent. As the strength of

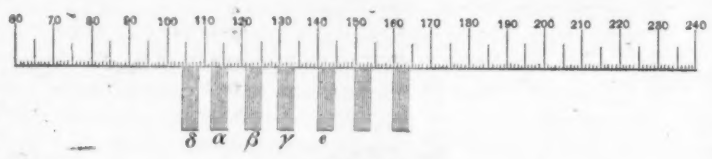


Fig. 14.

the acid is increased, however, and the conditions are more favorable to the stability of persulphuric acid, less hydrogen dioxide will be produced, and there is more chance of the alkali released from the sodium sulphate during electrolysis damaging the plates.

Also, Dr. Marshall has succeeded in preparing pure persulphuric acid, and has shown this year that it forms salts with the alkalies which are very stable; and what the effect on a cell of the formation of sodium persulphate in it would be is quite unknown. Although the formation of peroxides in the acid does not apparently account for the great gassing and sudden loss of charge sometimes observed, still we have seen that makers are reverting to Planté's process of manufacture, or modifications of it, and we may find that in this case also he was right, and that it is to the electrolyte we must look if we wish to find the means of materially improving the lead reversible battery.

In conclusion, I must thank the firms who have assisted me in the compilation of this paper by supplying information in response to circulars sent out. This information has also been used in the table given on the preceding page.

(*Copyrighted, 1890.*)

Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

In conjunction with Mr. Alexander Munro, Fowler published a work on animal electricity (translated in German under title of "Adhandlung ueber Thierische elect., etc.,") while, in the "Bibliotheca Britannica" for May, 1796, mention will be found of the observations of Dr. Fowler on the muscular irritability excited by electricity, on the reproduction of the nervous substance, on the action of poisons, on the phenomena of muscular contraction, etc., etc.

See "Essays and Observations, etc.," Edinburgh, 1793, in Library of the Royal Institution; Gilbert Blane's paper read to the English Royal Society, of which an extract can be found in Bacher's "Medical Journal," vol. XC., page 127; Figuier, "Exp. et Hist. des Princip. Dic.," vol. IV., page 309; C. H. Wilkinson, "Elements of Galvanism," London, 1804, chapter VI., *et passim*; Eighth "Encyc. Brit.," vol. XXI., page 634.

A. D. 1793.——Dalton (John), LL.D., F. R. S., a very able English natural philosopher and the illustrious author of the "Atomic Theory of Chemistry and of the Constitution of Mixed Gases," gives in his earliest separate publication, "Meteorological Observations and Essays," the result of the many experiments upon the electricity of the atmosphere, made by him at Kendal and at Keswick during the seven years ending May, 1793.

He proved, as Sir David Brewster expresses it, that the aurora exercises an irregular action on the magnetic needle, that the luminous beams of the aurora borealis are parallel to the dipping needle; that the rainbow-like arches cross the magnetic meridian at right angles; that the broad arch of the horizontal light is bisected by the magnetic meridian; and that the boundary of a limited aurora is half the circumference of a great circle crossing the magnetic meridian at right angles, the beams perpendicular to the horizon being only those on the magnetic meridian.

In the Eighth "Encyclopædia Britannica" (vol. IV., page 246), treating of the height of polar lights, reference is made to the extraordinary aurora borealis observed by Dalton on the 29th of March, 1826, and of which a description is given in a paper read before the Royal Society, April 17, 1828. (See *Phil. Mag. or Annals*, vol. IV., page 418; *Philosophical Transactions* for 1828, part II.; James Hoy in *Phil. Mag.*, vol. LI., page 422; J. Farquharson in *Phil. Trans.* for 1839, page 267.) It was seen in places one hundred and seventy miles apart and covered an area of 7,000 to 8,000 square miles. In volume XIV. of the same Encyclopædia will be found (page 15) an account of the aurora observed at Kendal, February 12, 1793, while at page 12 are given Dalton's views as to the connections between the heat and magnetism of the earth, and, at page 66, his conclusions as to the cause of the aurora and its magnetic influence.

See "Memoirs of Dalton's Life," by Dr. W. C. Henry, London, 1854; "Life and Discoveries of Dalton," in *British Quarterly Review*, No. 1; *Pharmaceutical Journal*, London, October, 1841; Thomson's "History of Chemistry," vol. II., Young's "Course of Lectures," London, 1807, vol. I., pages 706–709, 753, and vol. II., pages 466–470; Noad, "Manual," etc., London, 1859, pages 226, 269, 534; article, "Aurora Borealis," immediately following A. D. 1683; Sir H. Davy, "Bakerian Lectures," London, 1840, pages 322, 323, 328–330.

A. D. 1793–1797.——Robison (John), a very distinguished English natural philosopher, completes what are without question the most important of all his scientific publications. These are to be found throughout the 18 volumes and two supplements to the third "Encyclopædia Britannica," where they cover such subjects as Physics, Electricity, Magnetism, Thunder, Variation, etc., etc. Taken together, "they exhibited," according to Dr. Thomas Young, "a more complete view of the modern improvements of physical science than had previously been in the possession of the British public."

After his retirement from the navy, Robison devoted himself to scientific studies, becoming the successor of Dr. Black in the lectureship of chemistry at the University of Glasgow during 1766, and, seven years later (1773), he accepted the professorship of natural philosophy at Edinburgh, where he taught all branches of physics and of the higher mathematics. In 1783 he was made Secretary of the Philosophical Society of Edinburgh, received the degree of Doctor of Laws, 1798-1799, and was elected foreign member of the Saint Petersburgh Academy of Sciences in 1800. Of him, Mr. James Watt wrote, Feb. 7, 1805, "He was a man of the clearest head and the most science of anybody I have known" (Arago's Eloge of Jas. Watt, London, 1839, page 81).

It was while acting as midshipman under Admiral Saunders that Robison observed the effect of the aurora borealis on the compass, which had been remarked by Hiorter, Wargentin, and Mairan, several years before, but which was not then generally known. The aurora borealis, he afterwards wrote, "is observed in Europe to disturb the needle exceedingly, sometimes drawing it several degrees from its position. It is always observed to increase its rate of deviation from the meridian; that is an aurora borealis makes the needle point more westerly. This disturbance sometimes amounts to six or seven degrees, and is generally observed to be greatest when the aurora borealis is most remarkable. . . . Van Swinden says, he seldom or never failed to observe aurora borealis immediately after any anomalous motion of the needle, and concluded that there had been one at the time, though he could not see it. . . . This should farther incite us to observe the circumstance formerly mentioned, viz., that the South end of the dipping needle points to that part of the heavens where the rays of the aurora borealis appear to converge. . . ."

The experiments of J. H. Lambert (A. D. 1766–1775) upon the laws of magnetic action were carefully followed and repeated by Robinson, who, in 1769 or 1770, tried various methods and made numerous investigations from which he deduced that the force is inversely as the square of the distance. When he observed, however, some years afterward, that Æpinus had in 1777 conceived the force to vary inversely as the simple distance, he carefully repeated the experiments and added others made with the same magnet and with the same needle placed at one side of the magnet instead of above it. By this arrangement, which greatly simplified the process, the result of the whole was still more satisfactory. The inverse law of the square of the distance was therefore well established.

In his numerous experiments Prof. Robison found that when a good magnet was struck for three-quarters of an hour, and allowed in the meantime to ring, its efficacy was destroyed; although the same operation had little effect when the ringing was impeded; so that the continued exer-

*Continued from The Electrical World, Jan. 16, 1892.

tion of the cohesive and repulsive powers appears to favor the transmission of the magnetic as well as of the electric fluid. The internal agitation, produced in bending a magnetic wire around a cylinder, also destroys its polarity, and the operation on a file has the same effect. Mr. Cavallo found that brass becomes generally much more capable of being attracted when it has been hammered, even between two flints; and that this property is again diminished by fire: in this case Dr. Thomas Young remarks, it may be conjectured that hammering increases the conducting power of the iron contained in the brass, and thus renders it more susceptible of magnetic action.

Of his other very important observations in the same line it would be difficult to select the most interesting, and it may suffice to call attention merely to such as are noted throughout Prof. Alfred M. Mayer's valuable contributions on "The Magnet, Magnetism, etc.," in Johnson's New Universal Encyclopedia, as well as in his "Practical Experiments in Magnetism, etc.," published through the columns of the *Scientific American* supplement.

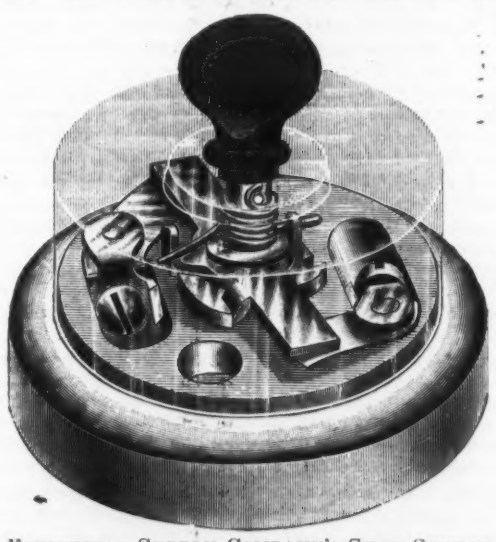
Prof. Robison's investigations in electricity are scarcely less interesting. In the theories advanced by Æpinus and Cavendish it was shown that the action of the electrical fluid diminished with the distance, while Mr. Coulomb proved, by a series of elaborate experiments, that it varied like gravity in the inverse ratio of the square of the distance. Robison had previously determined, without, however, publishing the result of his experiments, that in the mutual repulsion of two similarly electrified spheres the law was

FIG. 3.—LINE WIRE HOLDER.

slightly in excess of the inverse duplicate ratio of the distance, while in the attraction of oppositely electrified spheres the deviation from that ratio was in defect; and he hence justly came to the same conclusion as formed by Lord Stanhope, that the law of electrical attraction is similar to that of gravity.

A New Snap Switch.

The illustration shows a new snap switch, which is the design of Mr. Charles West, of Chicago. It embodies some new ideas in construction, is small in size, but has a large carrying capacity, as it is stated it will break the full current on 220 volts without injurious sparking. It would seem that the field was fairly well covered in the line of switches and other interrupting or controlling devices for electric currents; but new ways and methods are constantly coming up, each with claims of superiority. This new switch is



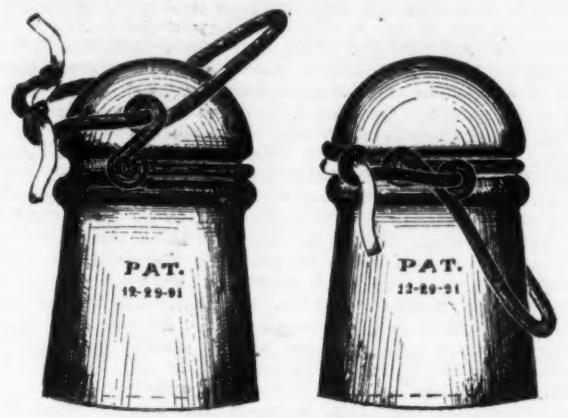
ELECTRICAL SUPPLY COMPANY'S SNAP SWITCH.

neat in finish and appearance, and is being manufactured and placed on the market by the Electrical Supply Company, of Chicago.

The G. S. A. Line Wire Holder.

The illustrations show three types of an improved "Tie Wire" for telegraph or electric light and power lines, to which the lines may be easily applied or released, greatly facilitating the work of the linemen. Figs. 1 and 2 are for telegraph and telephone work, Fig. 3 for light or railway feeder wire.

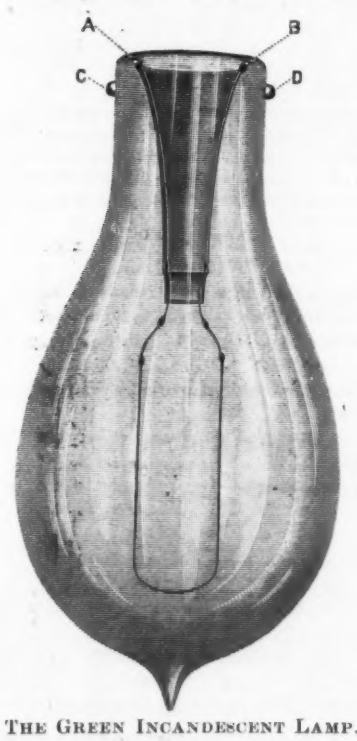
The standard insulators are used with this invention, which consists of a neck band sprung into an annular groove of the insulators, a U-shaped lever pivoted to said neckband and provided with eyes, and a fastening bail or link that is pivoted to said eyes and provided with a bent or hook shaped portion for engaging the line wire, said bent portion pressing the wire, when the lever is swung in a downward direction, into the annular groove of the insulator, so that the rounded end of the bail forms a continuation of the neck band, in which portion the line wire is firmly locked to the insulator. It is stated that this device can be applied to or detached from the insulator with great facility, and that its strength, reliability and inexpensiveness are the principal points of recommendation in its favor. The inventor is Mr. G. Sacco Albanese, of Lynn, Mass., formerly of Orange, Mass.



FIGS. 1 AND 2.—LINE WIRE HOLDER.

A New Incandescent Lamp.

We show in the accompanying illustration an ingeniously contrived incandescent lamp, for which a patent has recently been allowed to Mr. H. Green, of 160 Sisson avenue, Hartford, Conn. The illustration shows one of the many forms in which the lamp head can be constructed; the glass being blown into molds, it is only necessary to change the form of the molds to make the lamp fit any socket. It is claimed that the lamp will be cheapened also in cost to the extent of the metal cap now in general use. Contact is made directly on the leading-in wires, which are trained up either side of the well-shaped aperture in the neck and fused to the top at *A* and *B*. These pins are used in other lamps to connect with the socket;



THE GREEN INCANDESCENT LAMP.

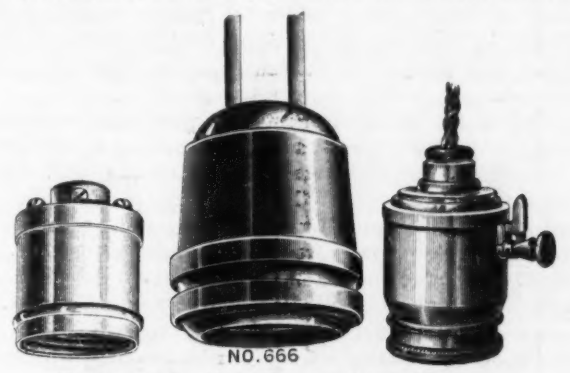
this has solid glass projections *C* and *D*, which work equally as well. This is a new departure and is regarded as a point in favor of its appreciation by the trade, with which it will undoubtedly meet with commercial favor. It is stated that Mr. Green has perfected a lamp, from which the filament can be taken out and replaced without injury to the bulb. A patent has been allowed for it and during the past seven months it has been thoroughly tested and it is stated is a perfect success, as a stronger vacuum can be formed in it, a 70-volt filament bearing a 108-volt current without apparent injury.

Edison Lamp Sockets.

With the rapid strides which are being made in electrical development, it would seem that the ingenuity of inventors would be taxed to bring out appliances of the kinds necessary for properly controlling the electrical current and also adapted to the many requirements of the users. The development in electrical appliances is quite as far advanced in small as in large apparatus, and the advancement has perhaps been as great in the socket as in the dynamo, considered in size and importance. Latterly inventive genius has been devoted to the diminution in the size of the socket, and has succeeded in reducing it about two-thirds.

The Edison General Electric Company has devoted considerable time and attention to the perfecting of sockets. The standard Edison sockets are still distinctively characteristic, and the accompanying illustrations show the several types as at present manufactured. The tongue socket is one of the familiar types. Another key socket has been designed, however, but is not intended to displace the former. The pressure or push-button socket was devised for use on flexible and other one-light pendants, and has the advantage of operation by one hand. It is of the same size as the key socket, but instead of the key it has a small push button, and a retaining catch. The other end of the rod holding the button consists of a small conical plug of insulating material with a metallic collar. Pressure on the button pushes the collar between a set of small brushes, and the contact then made is retained by the small catch. To extinguish the light requires a very slight pressure on the catch, releasing the button, and a spring throws it out, thus breaking the contact instantaneously. The use of the Edison standard keyless socket on artistic fixtures has, on account of the demand for more artistic fixtures, been a matter of considerable importance, and a small keyless socket has been brought out, the use of which will do away with the heavy appearance given to fixtures by the larger keyless socket. This socket, it is claimed, possesses several excellent features, being simple in construction, and in efficiency all that could be desired. Its dimensions are about 1¼ inches by 1 inch, and it is said to be the smallest keyless socket for lamps of 16 c. p. and upward now before practical electricians.

A socket for use in breweries, laundries, dye-houses, and other locations where steam and acid fumes exert a disas-

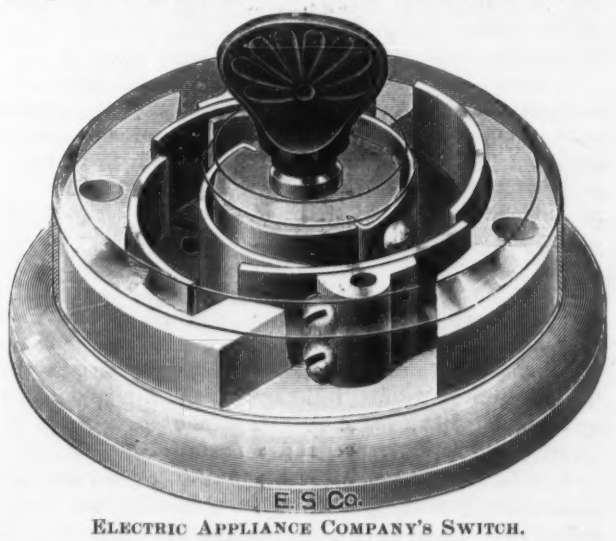


FIGS. 1 TO 3.—NEW EDISON LAMP SOCKETS.

trous influence on ordinary insulation, having become a necessity, the Edison company has brought one out, the shell of which is of hard rubber. The interior parts are embedded in insulating material, impervious to moisture and offering excellent resistance to acids, and the rubber covered connecting wires are led out through small holes at the top of the shell. All Edison sockets, with the exception of the last mentioned, will shortly have all their insulation of porcelain. To meet the demand for porcelain electrical devices, the Schenectady works have been increased by a large porcelain factory, where are employed experienced men whose ability in that line of work is undoubted. Any new developments in the line of socket innovations which the Edison General Electric Company is contemplating will be awaited with great interest.

A New Single Pole Switch.

The illustration shows a new double break switch, which is called the "Acme" single pole, and which combines many new and desirable features in construction not before attempted. It measures less than three inches all over and has but two working parts. It is operated by a thumb piece which unscrews when turned backward and its action is easy and positive. The double break, which combined measures more than 1¼ inches, will it is stated break several times the voltage in ordinary use, insuring long life to the switch. The motion of the bar passing over the flexible bronze brushes keeps the contact surfaces clean and bright. Among the features in its construction is the manner of making connection, by means of which the wires entering the switch are always open to inspection and require no extra perforations in the base for their admission to the terminals. A unique device is also embodied in it by which the bar is released at the proper time and is prevented from turning backward, and it does not depend upon friction between any of its parts to retain the bar until the handle



ELECTRIC APPLIANCE COMPANY'S SWITCH.

is given the required turn to release it. It is manufactured and is being placed upon the market by the Electric Appliance Company, of Chicago, and it is evidently a desirable addition to the company's large list of specialties.

The Electric Mutual Insurance Company.

The Electric Mutual Insurance Company, which for some time past has been doing a most successful business in Boston, has perfected an arrangement with the Home Insurance Company, of New York City, whereby its policies will be reinsured in the Home company, and the Electric Mutual will cease to issue policies. The following letter has been issued by Mr. S. E. Barton, president of the company, under date of Jan. 7:

To the Policy Holders of the Electric Mutual Insurance Company:

The directors of this company have this day executed a contract whereby the entire liability under all of its outstanding policies is assumed by the Home Insurance Company of New York City, and the Electric Mutual will forthwith cease issuing policies. This action was taken because it was deemed to be for the best interests of the policy holders as well as of the electrical industries in general.

The year 1891 was one of the severest in fire losses ever known. Eighty-two fire insurance companies ceased doing business during the year, and 38 of them were mutual companies. Twenty-three of the latter failed outright, many of them making miserable failures, disclosing dishonesty and in several instances involving additional assessments upon their policy holders to pay incurred losses and expenses.

While nearly all of these mutuals were what are designated in insurance circles as "Western Wildcat Mutuals." The difference between them and legitimately conducted companies is not generally known by the insuring public, and therefore any company doing business upon the mutual plan must suffer greatly from the confidence forfeited by these failing concerns. Our company has felt this lost confidence to a serious degree during the year, and our business would have suffered beyond endurance had it not been for the high reputation of the gentlemen composing our board of directors and indorsing the company.

Owing to an unusual number of fires in electrical property we were losing the support of companies that had helped us to carry the large amount of insurance on many of our risks. West of the Mississippi River we were practically deprived of such support.

The laws of nearly all the States are such that an insurance company without a *paid-up cash capital* of $200,000 or more is denied a license to transact business, and if a representative of such unlicensed company is found soliciting insurance he is subject to arrest and heavy fine. Furthermore, the policies of unlicensed companies are not infrequently declined by bondholding institutions and other collateral interests. This aggregation of obstacles made a change of some sort imperative. The raising of a large cash capital and the reorganization of the Electric Mutual on that basis was considered by the directors, but before action was taken, negotiations were opened with the Home Insurance Company, resulting in the very liberal proposition contained in the letter hereto appended and signed by Mr. D. A. Heald, president of that company.

By the reinsurance effected to-day, all losses under Electric Mutual policies are guaranteed by the Home with its ten million dollars of assets, and the possibility of an assessment on the Mutual policies is thereby removed.

In accordance with the spirit of Mr. Heald's letter, the formation of a syndicate is in progress, six of the largest stock companies having joined the Home already. I am confident that enough more will shortly join to make an association that will carry the whole insurance on the largest of the electrical risks and insure the carrying out of the proposition for fair and equitable treatment in the matter of rates.

Under the new plan the renewal of policies now in the Electric Mutual and those placed through us with other companies may be effected with the undersigned as agent for the syndicate companies, the policies to be made by the companies' agents residing where the property is located. By that arrangement the local agent becomes interested in the insurance and a friend of the electrical company. A system of inspection, more complete than the Mutual has been able to maintain, will be continued by the same corps of inspectors.

For the time being the business will be conducted from the present office of the Electric Mutual, but in the near future it will doubtless be found advisable to locate the office in New York City, of which due notice will be given.

The present status of the Electric Mutual will remain unchanged until all of its policies have expired, and any indorsements, consents, or other required changes will be promptly made, as heretofore, by communicating with the company and forwarding policies for the purpose of indorsement. Yours respectfully,

STEPHEN E. BARTON, President.

Mr. Barton will have entire charge of the electric insurance department of the Home company as its general manager and the work will be carried on under practically the same management as when performed by an independent company. The headquarters, however, as is stated above, will probably be ultimately transferred to this city.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

A continually declining market throughout nearly the entire list of securities has not materially affected the electric stocks, as these have remained practically unchanged. This is due mainly to the fact that they are held almost entirely for investment, and are not at all affected by speculation. Then, too, the general stock market is dependent not only upon local conditions, but its condition from day to day is that of all the principal markets of the country and London. The strength of electric securities in the market is subject almost entirely to local influences; and this must always be so as long as this class of stocks is so limited in the number of people which they reach. Great progress has been made during the past year in establishing confidence in this new line of stocks; and now there should be a corresponding interest shown in placing electric companies' bonds on an equal footing with other bonds. There is at present an effort being made in one of the principal markets to have electric bonds listed in the stock exchange for regular trading. This is the first step in the right direction, and would give the investor confidence in them, and also place them within easy access of purchasers. Referring to the organization of new corporations, the *Bulletin-Maker* recently had the following: It is an invariable rule that the most practical enterprises are capitalized at the smallest figure. Hundreds—it would hardly be exaggeration to say thousands—of electric light, heat, power and railway companies have been organized in the States during 1891. In almost every instance the capital stock named has been insignificant. Companies to furnish cities of 20,000 inhabitants with light, heat and power have been started with from $10,000 to $20,000 capital. Trolley electric street railway companies to build and operate several miles of road start on a basis of only $4,000 or $5,000 a mile. The plant is all that such companies have to provide. There is no raw material to buy, and the labor is chiefly mechanical. In most manufactures the raw material and labor are the chief items of cost; in the electrical business there is neither of these original costs to eat up profits or to require large capital originally. The corporations whose stock are most eagerly sought by capitalists? Capitalists want long bonds, they prefer a 40-year bond at low interest to a 20-year bond at higher rates. Of late years street railway bonds have been largely dealt in. They are now generally regarded as among the safest investments, and the bonds of those adopting the cable or trolley system are readily sold. Here are a few street railway issues of the past few months:

Borrower.	Amount.	Purchaser.
Baltimore City Passenger R. R. Company	$200,000	Alex. Brown & Son.
Richmond Railway and Electric Company	1,300,000	J. H. Davis & Co.
Atlanta Traction Company	150,000	Fisher & Shaw.
Davenport and Rock Island R. R. Company	100,000	H. W. Harris & Co.
Pittsburgh Second Avenue Pass R. R. Company	200,000	Unsold.

Dividends.—It is very noticeable how many electric stocks there are in the list of companies that pay January dividends. This is more evident this year than ever before, for now all the larger companies are firmly established in paying regular dividends; and in percentage they are above the average.

Westinghouse Certificates.—The new certificates of the "assented stock" of the Westinghouse Company are ready for delivery at the office of the Mercantile Trust Company, which is the trustee for this stock. The stockholders' meeting is due in a few days, and at that time it is expected that a final settlement of the reorganization plan will be made.

The Detroit Electrical Works paid a dividend of two per cent. Jan. 15.

The North-West Thomson-Houston Electric Company paid a dividend of two per cent. on common stock Jan. 15.

The American Bell Telephone Company paid a dividend of $3 per share Jan. 15.

The Western Union Telegraph Company paid a dividend of 1¼ per cent. Jan. 15.

The Edison General Electric Company pays a dividend of two per cent. Feb. 1.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Jan. 16, 1891, in New York and Boston:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	86,200,000	83¼	83¾
American Telegraph & Cable	100	14,000,000	....	82
Central and South American	100	5,000,000	....	....
Mexican	100	2,000,000	....	....
Commercial Cable Co	100	7,716,000	....	....
Postal Telegraph Cable	100	5,000,000	28	33
Edison General Electric	100	15,000,000	90	92
Consolidated Electric Light	100	2,500,000	20	30
Edison Illuminating Co., of New York	100	4,500,000	81	82
" " " Brooklyn	100	750,000	74	78
" " " Boston	100	1,263,500	97½	102½
" " " Chicago	100	750,000	135	145
U. S. Illuminating Co	100	1,250,000	30	35
North American Phonograph Co	..	....	2½	5
New York Phonograph Co	100	6,200,000	2½	5
Edison Elec. Light Co. (of Europe) stock	100	2,000,000	2½	5
" " " " bonds	..	30,000	65	75
" Ore Milling Co	100	2,000,000	17½	22½
" Toy Phonograph Mfg. Co	10	1,000,000	....	½
U. S. Electric Light Co	100	1,500,000	15	20
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co	..	500,000	....	60
East River Electric Light Co	100	1,000,000	....	60
Thomson-Houston Electric Co	25	6,000,000	50¾	50½
" " preferred	25	4,000,000	26⅜	26½
Thomson-Houston Electric Co.—Series C	..	40,000	7⅞	8⅛
Thomson-Houston Electric Co.—Series D	..	120,000	7⅛	7¼
" International Electric Co	100	400,000	175	200
Thomson-Houston International Electric Co—Pfd	100	250,000	101	104
Thomson Electric Welding Co	100	1,000,000	40	55
" European Electric Welding Co	100	1,500,000	14¾	15
Westinghouse Electric Co	50	7,000,000	12½	13⅝
Fort Wayne Electric Co	25	4,000,000	12½	12⅝
Fort Wayne Electric Co.—Series A	..	80,000	6⅞	7
Detroit Electrical Works	10	1,0 0,000	8¾	9
West End St. Ry. Co.—Com	50	7,150,000	72	72¼
West End St. Ry. Co.—Pfd	50	6,400,000	84½	84¾
American Bell Telephone	100	15,000,000	210	211
Erie Tel. & Tel. Co	..	....	43½	44
Mexican Tel. Co	..	.....	115	125
New Eng. Tel. & Tel. Co	..	....	51	52
Tropical Tel. Co	..	.... .	....	50c.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Chicago	$224@ $226	Cumberland	$60@ $62
Central Union	52@ 53	Wisconsin	118@ 120
Michigan	81@ 83	Bell of Missouri	175@ 180
Great Southern	30@ 32	Missouri & Kansas	54@ 56
Colorado	34@ 36	Iowa Union	20@ 22
Rocky Mountain Bell	40@ 43		

ELECTRICAL STOCKS.

Chicago Arc Light and Power	$82@ $83	Chicago Edison Co	$140@$142

NEW INCORPORATIONS.

The Mercantile Telegraph Company, of Chicago, Ill., with a capital stock of $100,000, has been formed to construct telegraph lines, etc., etc. Julius Schweiger, George Einstein and Henry H. Kennedy are the incorporators.

The Pneumatic Transit Company, of Camden, N. J., with a capital stock of $500,000, has been formed to operate and use pneumatic and electrical inventions. W. J. Kelly, J. K. Gittens, Jr.; H. Geiger and A. DeCornea, all of Philadelphia, Pa., are the incorporators.

The Paris Electric Light and Railway Company, capital stock $800,000, of Paris, Tex., has been incorporated for the manufacture and supply of light and electric power, and the operation of a street railway. S. J. Wright, J. J. Walsh and John Martin are the organizers.

The Ellenville Electric Company, of Ellenville, Ulster county, N. Y., with a capital stock of $30,000, has been organized to generate electricity for light, heat and power. John H. Kemp, John B. Murray, both of Delhi, N. Y., and Edwin Russell, of Ellenville, are the incorporators.

The Marshall Electric Company, of Marshall, Ill., with a capital stock of $20,000, has been formed to construct and operate an electric light and power plant in Marshall and furnish light and power to that city. Emma Ewalt, Annie J. Travis and C. C. Travis are the parties interested.

The Citizens' Passenger Railway Company, of Steelton, Pa., with a capital stock of $100,000, has been formed to operate an electric street railway in Swatara township and Steelton, Pa. S. S. Page, of Oberlin, Pa.; M. F. Snavely and C. L. Brinson, both of Harrisburg, Pa., are its promoters.

The Fair Electric and Manufacturing Company, of Hoboken, N. J., with a capital stock of $100,000, has been incorporated to manufacture and repair electrical machinery and devices of every kind. The promoters are J. Fehr and L. A. Fehr, of Hoboken, and G. Cronemeyer, of New York.

The Citizens' Electric Light, Power and Heat Company, of Dubois, Pa., has been incorporated with a capital stock of $2,000, for the purpose of supplying light, heat and power by electricity to the public. Chas. E. Bostwick, J. A. Terpe and Geo. E. Grier, all of Dubois, are the organizers.

The Monte Cristo Mining and Improvement Company, of Seattle, Wash., capital stock $100,000, has been formed to deal in and operate mines, mills, railroads, telegraphs, electric light plants, etc., etc. A. W. Hawks, of Snohomish, A. T. McCargar and J. P. Hendricks, of Seattle, are the promoters.

The Westmoreland Electric Company, of Greensburgh, Pa, has been organized, with a capital stock of $50,000, for the purpose of supplying light, heat and power by means of electricity to the borough of Greensburgh, etc. Daniel Manahan, E. H. Pair, J. E. McFarland, all of Greensburgh, Pa., are the promoters.

The Forest Park Electric Street Railway Company, of Pittsburgh, Kan., capital stock $50,000, has been organized to construct and operate an electric railway. Ed. Van Gundy, W. A. Swan, W. D. Ford, all of Pittsburgh, Kan.; G. H. Harris and W. H. Breckenridge, both of Kansas City, Mo., are the promoters

The Dixon Power and Lighting Company, of Dixon, Ill., with a capital stock of $75,000, has been started to manufacture and sell gas, electricity and any other illuminating agency for lighting, heating, power and other purposes. The incorporators are as follows: F. A. Watson, A. C. Bardwell and F. A. Truman.

The Galena City Mining and Investment Company, of Seattle, Wash., capital stock $60,000, has been incorporated to deal in and operate mines, mills, etc., railroads, telegraph and telephone lines, electric light plants, etc. A. T. McCargar, Wm. A. Jones, both of Seattle, and J. W. Heffner, of Snohomish, are the promoters.

The Montgomery Electric Light and Power Company, of Montgomery, W. Va., capital stock $50,000, has been formed to supply electricity for lighting and power in Montgomery, supplying gas, constructing water-works, etc. The organizers are T. B. Davis, J. W. Montgomery, J. C., O. L. and Seth Montgomery, all of Montgomery.

The American Aluminium Company, of Denver, Colo., has been formed with a capital stock of $2,000,000, to manufacture aluminium and magnesium by electricity and other processes, selling and dealing in aluminium and other products, etc. Henry Harper, Robert McKnight and John A. Proud, all of Philadelphia, Pa., are the incorporators.

The Castle Electric Company, of Castle, Mont., has been incorporated, with a capital stock of $50,000, for the purpose of dealing in electrical appliances, and utilizing same for lighting, power and manufacturing purposes. John L. Frazer, Hanson H. Barnes, Nahum T. Dinsmore, Geo. E. Simon and Chas. E. Miller, all of Castle, are the incorporators.

The Sierra Valley Telegraph Company, of Sierraville, Cal., capital stock $20,000, has been formed to construct and operate a line of wires or electromagnetic telegraph attached to poles. Maurice Fritchard, Sierraville; Ed. J. Freeman, Sierra Valley; W. H. Lanon, Sierra City; Joseph Escoe, Loyalton, and Jos. R. Escoe, of Beckwith, are the promoters.

The American Watchman's Time Detector Company, of Jersey City, N. J., with a capital stock of $100,000, has been formed to manufacture and sell electrical clocks, electrical fire alarms and other electrical and mechanical appliances, etc. J. S. Morse, A. G. Morse, E. B. Seeley, all of New York, and C. L. Carrick, of Jersey City, are the promoters.

The Shelbyville Electric Street Railroad Company, of Shelbyville, Shelby County, Ind., capital stock $100,000, has been formed to construct and maintain and operate a system of street railroads, switches, etc., and all necessary turnouts, to be operated by electricity as the motive power, etc., etc. Geo. M. Ray, Geo. S. Oefelein and W. S. Ray are the incorporators.

The City Electric Railway Company, of Decatur, Ill., with a capital stock of $300,000, has been formed to purchase, construct and operate a system of street railway in Decatur, and to furnish power for mechanical, manufacturing, lighting and heating purposes. The organizers are D. S. Shellaberger, James Milliken, B. O. Reynolds, W. H. Starr, I. R. Mills, D. W. Brennaman and W. L. Ferguson.

AFFAIRS OF THE COMPANIES.

The Malden Electric Company, of Malden, Mass., has declared a quarterly dividend of 2 per cent.

The Traylor Electric Plant, at Richmond, Va., was resold by a receiver recently to Henry Smith for $9,200.

The Manhattan Electric Light Company, of New York, held its annual meeting Jan. 18 at 10 o'clock A. M.

The Valdosta Electric Light Company, of Valdosta, Ga., has declared a semi-annual dividend of 6 per cent.

The Harlem Lighting Company, of New York, held its annual meeting Jan. 19 for the election of trustees and directors.

The California Electrical Works, of San Francisco, Cal., held its annual meeting Jan. 20 for the purpose of electing its directors and transacting other business.

The Dubuque, Ia., Electric Railway, Light and Power Company has given a mortgage for $200,000 to secure $200,000 of six per cent. bonds which run until 1897.

The Belknap Motor Company, of Portland, Me., it is stated, will go into the manufacture of electric motors, dynamos, etc., more extensively during this year than before.

The Brush Electric Light Company, of Indianapolis, Ind., has recently purchased for $16,000 a plot of ground on which a large building will be erected for increasing its power supply.

The United Electric Railway, of Nashville, Tenn., has executed a trust deed to secure the issue of $200,000 mortgage bonds, bearing six per cent. interest, running 10 years in three series.

The International Land and Investment Company, of Covington, Ky., capitalized at $1,000,000, has recently acquired the Queen City Electric Street Railway system of Marion, Ind.

Electric Light Companies Merged.—The Harrisburg and Excelsior Electric Light companies, of Harrisburg, Pa., it is stated, have effected a consolidation, thereby settling a long fight for supremacy.

The Emerson Electrical Manufacturing Company, of St. Louis, at its annual meeting voted to increase its capital stock to $25,000. Mr. Alexander Meston was elected superintendent and J. W. Emerson president.

The Topeka Water and Electric Power Company, of Topeka, Kan., recently organized under the laws of Colorado, capital stock $500,000, is to relinquish its Colorado charter and reincorporate under the laws of Kansas, increasing its capital to $650,000.

The Lincoln Street Railway Company, of Lincoln, Neb., which is a consolidation of the Lincoln Rapid Transit Company and the Lincoln Street Railroad Company, capital stock 23,000 shares, is offering bonds aggregating $2.300,000, 5,000 of which are preferred 7 per cent. shares.

The People's Electric Light Company, of Trenton, N. J., at its recent annual meeting elected the same officers and directors as for the ensuing year. The officers are: J. Moses, president; J. T. Ridgway, vice-president and general manager; W. B. Allen, treasurer; A. C. Yard, secretary.

The South Covington and Cincinnati Street Railroad Company has executed a mortgage for $500,000, hypothecating all of its property in Covington, Cincinnati and Newport, together with its franchises and rolling stock, for the purpose of equipping the entire system with electricity.

The Essex County Electric Light Company, of Orange, N. J., at its recent annual meeting elected the following officers and directors: President, E. E. Sage; vice-president, W. B. Boulton; treasurer, E. C. Clay; secretary, C. A. Lindsley; directors, the above and C. G. Kidder, S Lindsley and S. D. Day.

The Rockford Electric Manufacturing Company, of Rockford, Ill., held its annual meeting Jan. 12. The following officers and directors were elected: President, C. M. Haven; vice-president, G. E. Knight; secretary, treasurer and general manager, W. B. Roberts; superintendent and electrician, Geo. A. Mayo. Directors, W. T. Woodruff, E. H. Marsh, J. W. Calkins, Geo. T. Penfield.

Holyoke, Mass.—At a meeting of the directors of the Holyoke Street Railway Company, the matter of advising the stockholders to vote to extend the line to Oakdale and Springdale was considered, also of building a power-house and furnishing power at a cheaper rate. In order to make these improvements it is estimated that the capital stock will have to be increased to $125,000, and if not to about $75,000.

The American District Telegraph Company, at its stockholders' meeting Jan. 12, approved the purchase of the Mutual District Telegraph Company. It is stated that the price paid is $1,275,000, which will be provided for by increasing the capital stock of the former company from $3,000,000 to $4,000,000, and issuing 10,000 shares of new stock to provide for the balance of the purchase money.

R. T. Oakes & Co., dealers in electrical supplies, of Holyoke, Mass., have dissolved. A stock company has been incorporated under the name of the Roland T. Oakes Company, and the business will be continued the same as before. The new company has been organized with R. T. Oakes president and treasurer and A. J. Newell, secretary. The facilities for carrying on the business will be largely increased.

The Central Thomson-Houston Company, of Cincinnati, O., at its recent annual meeting elected the following officers and directors: Franklin Alter, president; H. P. Piper, vice-president; A. B. Champion, secretary; Paul T. Brady, treasurer and general manager, and W. F. Hays, assistant treasurer. Franklin Alter, James Dalton, H. P. Piper, E. I. Garfield, A. B. Champion and A. Stuart are the directors.

The Shippensburg Electric Light Company, of Shippensburg, Pa., held its annual meeting on Jan. 11. The stockholders expressed themselves as very much pleased with the results of the year's work, with prospects very encouraging for an increased revenue for the present year and a reduction of running expense. No change was made in the board of directors. The officers are: J. C. Rummel, president; J. C. Fleming, secretary, and Clarence J. Reddig, treasurer.

The Newark (Ohio) & Granville Electric Railway, which connects the two places, is a line six miles in length operated by the Sprague system. It has five motor cars, five trailers and a mail and baggage car. It is stated that the road is doing good business and will have to increase its facilities. At its recent annual meeting the following officers were elected: President, R. Scheidler; vice-president, J. A. Flory; secretary, W. C. Christian; treasurer, F. A. Crane; passenger and excursion agent, W. C. Wells.

The Edison General Electric Company states that an erroneous impression seems to have been circulated in regard to the injunction granted by Judge Barrett, restraining the Edison Electric Light Company from paying a dividend. This injunction, the company claims, affects only the details of management of the Edison Electric Light Company, and has no bearing whatever upon the payment of the regular 2 per cent. quarterly dividend of the Edison General Electric Company, which will be paid Feb. 1, as usual.

The Edison Electric Illuminating Company, of New York, has declared a quarterly dividend of 1¼ per cent., payable Feb .1 .It is stated that the company earned last year enough to pay fixed charges, four per cent. dividends, and to carry over a very satisfactory surplus. The business has reached a point where the directors felt justified in advancing the rate of dividends to five per cent. Earnings justify the expectation that this rate can be maintained, and the gradual expansion of the business will carry the rate up to six per cent. later on.

The Brush Electric Company, of Cleveland, O., will hold its annual meeting in March, at which time the annual report will be read. The company has recently secured the services of Mr. W. S. Rogers, who was formerly connected with the Thomas Murray Company, of New York. During the past year it has invested upward of $150,000 in the improvement of its works, and they are now in better condition than ever before. The business has increased during the past three or four months, and was double what it was for the same period last year. The prospect for the coming year is most excellent, and an additional shop will be erected.

An important electrical consolidation and combination has been closed at Columbia, S. C., by the Congaree Gas and Electric Light Company, the Suburban Railway Company and City Railway Company, and the following new officers and directors have been elected: Messrs. Clark, Marshall, Lyles, Edwards, Childs, Moore and Thomas. President, J. Q. Marshall; vice-president, Dr. T. F. Moore; secretary and treasurer, W. G. Childs; solicitor, John T. Sloan. The Board of Directors was authorized to issue $150,000 in bonds for improvements, etc. The electric light service will be improved and electric power will be furnished. The deal is regarded as an important one.

Electric Lighting Combine.—A combination, looking to the consolidation of Central New Jersey lighting companies, is being worked, it is stated, by a large corporation which is gradually absorbing all the electric light companies in the central part of the State. Its object is to furnish light to all New Jersey towns lying between Plainfield and Elizabeth. The corporation recently bought out the Elizabeth Electric Light Company, and an alliance with the Plainfield company will soon be consummated, as the negotiations are said to be about completed. If an alliance is made between the two concerns, it is probable that all the towns between Elizabeth and Plainfield will be forced to accept the Westinghouse alternating system. It is stated that united action is being taken to prevent the combine gaining a foothold.

The West End Street Railway Company, says *Rialto* in the Boston *Advertiser*, at 72¼ looks cheap, and I have no doubt that investors will soon begin to look at it that way and come in and buy it. Cambridge people seem to be very much enamored over the double deckers which have recently been put on their line. They are said to run perfectly and be practically noiseless, producing no grinding or whistling sound. These cars are equipped with the Westinghouse motor, in which there is only a single reduction from the armature shaft to the axle, thus affording no likelihood for stripping the gears. The Westinghouse people are now turning out a motor without any reduction, the motor resting directly on the car axle.

The Galveston (Tex.) City Railway has done a vast amount of work in improvements during the past year. It has rebuilt 26 miles of track, and by May of this year will complete the balance of its lines, when it will have a total mileage electrically of 40 miles. It now operates 20 motor cars and 20 additional cars are to be delivered by May 1. The power-house was erected at a cost of $30,000, exclusive of the machinery used in it. In it are four 150-h. p. boilers, one 400-h. p. compound condensing Corliss engine, two compound condensing Westinghouse engines of 150 h. p. each, one Edison 250-h. p. generator and two Rae generators of 100-h. p. each. The company has expended to date over $300,000 for buildings, electrical equipment and reconstruction of lines and will spend an additional $100,000 to complete its system, for the purchase of more cars, motor equipments, etc. The company has expended during the past year over $100,000 for labor. The gross earnings for the past year have been $156,000, which represents 3,120,000 passengers carried, and an increase of $22,968 14 over the earnings of 1890. The net earnings for the year will aggregate $60,000.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Jan. 18, 1892.

Mr. M. E. Baird, general agent of the Eddy Motor Company, of Windsor, Conn., was in the city last week.

Mr. Ralph L. Shainwald, of the Standard Paint Company, with his family, has left the city on a trip to California.

Mr. H. Mc L. Harding, general manager of the Westinghouse Electric Company, is stopping at the Fifth Avenue, this week.

The Holmes Electric Protective Company will hold its annual meeting at the office of the company, 518 Broadway, February 5, at 3 P. M.

Mr. Fred C. Jempson, formerly with the Empire City Electric Company, has opened a New York office for the Electrical Engineering and Supply Company, of Syracuse, N. Y., at No. 18 Cortlandt street, Telephone building.

To Be Lighted by Electricity.—The electric lighting system of Saint Francis Xavier's church, on West Sixteenth street, has been completed at a cost of $3,500. The lights will be turned on for the first time next Sunday evening, at vespers, at 8 o'clock.

The National Electric Light Association.—Mr. Geo. F. Porter, secretary of the National Electric Light Association, has sent out the following letter to the associate members of the association: "The fifteenth convention of this association will be held in Buffalo, N. Y., Feb. 23, 24 and 25 next; headquarters at the Iroquois Hotel. Inquiries have been made regarding the holding of an exhibition in connection with the meeting, but the matter has not yet been decided. Should enough members signify their desire to exhibit to justify the management in taking such action, space and power will be provided *gratis*. Kindly advise me, at your earliest convenience, of your wishes in the matter."

Mr. Wm. S. Horry, formerly with the Ries Electrical Specialty Company, of Baltimore, Md., has located in this city for the purpose of developing some patents on a new system of isolated lighting. The system comprises an alternator, of which the armature consists simply of a copper wheel, which is of itself perfectly self-regulating. A current of low tension is used and the lamps are installed in multiple as in the Ries regulation socket. The lamp can be turned up or down, the same as gas, and it is stated that the saving in lamps and power is remarkable, the light being adapted to every requirement, being perfectly under control and especially applicable to domestic lighting. The system will be on exhibition in this city within a few days.

Mr. John A. Cross, consulting mechanical and electrical engineer, who opened an office in the Electrical Exchange building, 136 Liberty street, some three months since, reports that he is meeting with most gratifying success. Mr. Cross for the past 12 years has been associated with some of the largest concerns in the country, 6½ of which he was engaged in the designing and construction of steam engines and general machinery. During the past six years he has devoted his attention to electrical work. Until recently he was with the Brush Electric Company as superintendent of construction at the New York office, and during the time installed a large number of important plants for the company. He is prepared to make plans and designs for special plants and superintend the construction of the same. L. H. H.

ALBANY, Jan. 16, 1892.

The New Dynamo for the electric light works at West Troy will be in position in about two weeks.

The Incandescent Lights of the new electric light company at Greenwich, N. Y., have been started.

The Vermont State Normal School at Vergennes and the Congregational Church of Rutland will be lighted by incandescent lamps.

Since the collapse of the electric light plant in Whitehall, N. Y., the gas company has been busy restoring many lamps. The old system of lighting will soon be in vogue again in Whitehall.

The course of lectures that has been arranged for Union College, through the generosity of Gen. Butterfield, contains the following: "Electricity: Its Properties and Latest Development. By Albon Man, '49."

Bill Passed—Senator Parker's resolution requiring the commission appointed to revise the laws regarding the infliction of the death penalty to meet and make a further report in regard to publicity of executions.

The Stockholders of the Troy City Railroad elected the following directors Wednesday afternoon: Lewis E. Gurley, Levi Smith, James O'Neil, Peter McCarthy, E. Ogden Ross, Anthony N. Brady, Edward Murphy, Jr., William Kemp, Charles Cleminshaw, Joseph J. Hagen. Inspectors, Walter R. Bush, E. Ogden Ross, E. P. Schoonmaker.

The Lamp and Gas Committee of Lansingburgh has failed to meet and consider the proposition to light the village by electricity. Engineer Hicks has corresponded with prominent electric light firms, including the Thomson-Houston and Westinghouse companies, with a view of establishing a plant. The opinion seems to be general that the city should control the enterprise. It is estimated that 150 lamps will be necessary and that the cost will be $12,000.

The Troy & Lansingburgh Railroad Company elected the following directors Tuesday: William Kemp, Otis G. Clark, Charles Cleminshaw, Nathaniel B. Powers, H. B. Dauchy, Charles M. Tillinghast, Joseph B. Carr, Edward Murphy, Jr., Francis N. Mann, Jr., Shepard Tappen, Thomas Breslin, Peter McCarthy and James O'Neil. Messrs. Breslin, McCarthy and O'Neil are new members. The board organized in the afternoon and elected the following officers: Charles Cleminshaw, president; Joseph B. Carr, vice president, and J. J. Hagen, secretary and treasurer. Inspectors, William Kemp., Jr., Charles G. Cleminshaw and William H. Draper.

Many important bills have been introduced in the Legislature even at this early stage of the session. Some of them are as follows: By Assemblyman Kelly forbidding street railways on Ocean avenue, Brooklyn, changing their motive power except by consent of property owners. For a Board of Electric Light Commissioners in West Troy, by Assemblyman Gorman. Providing that six newspaper reporters shall be present at executions, by Senator Brown. Allowing the use of the Erie Canal for experiments with various motive powers, by Assemblyman Rice. Allowing street railways in cities less than 20,000 inhabitants to charge more than five cents for fare in certain cases, by Senator Mullin. Amending general railroad act relative to rates of fare by providing that street railroads in cities of 20,000 inhabitants may charge five cents extra for passage more than half a mile beyond the boundaries, by Assemblyman Willard. Providing for additional fares of five cents on Watertown street railway outside of the city limits, by Assemblyman Fuller. Providing for consent of property owners for construction of a railroad on Eighth avenue, Brooklyn, by Assemblyman T. F. Byrnes.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
927 CHESTNUT STREET, PHILADELPHIA, Jan. 16, 1892.

The Colonnade Hotel will soon install an electric plant.

Middletown, Pa., is about to install an electric light plant.

The Star Electrix Company is very busy at the present time.

Geo. W. La Rue, general sales agen t for the Crocker-Wheeler Company, was a recent visitor to this city.

Olyphant, Pa.—The City Council has rejected all bids for lighting the city and advertises for new bids.

The Universal Electric Engineering Company is well known to the trade. Its latest enterprise is the extension of its factories.

The Jenkintown Light Company is making additions to its plant. It now has 4,000-lamp capacity and is using National apparatus.

The Ajax Metal Company has just put in an electric plant, which was purchased from the Pennsylvania Electrical Engineering Company.

Horn, Brennan & Forsyth, whose goods are well known in the electrical field, report business in their several lines as being good for this season of the year.

Gill & Co., manufacturers of arc electric light globes, and shades of every description, are turning out large orders every day. They report business as being up to expectations.

The Pennsylvania Electric Engineering Company, Penn Mutual Building, is having a good trade for its lamps, and is also doing a considerable business in the supply line.

The Camden Thread Company.—Mr. McLaughlin, manager of this company, reports trade in the electrical line as very much improved. Its specialty is glazed thread for covering electric light wires.

The Electric Trust.—The City Council by a vote of 16 to 15, decided against ordering an investigation of electric lighting matters and of considering the question of establishing a plant for electric lighting under municipal ownership.

The Northern Electric Light Company is having trouble with merchants on Columbia avenue in regard to the price paid for electric light service, the merchants claiming that they pay 60 cents for service furnished others for 40 cents.

Wm. N. Marcus, 218 North Second street, is the inventor and manufacturer of the Marcus patent auxiliary mouth piece, also receiver support. Both of these articles can only be appreciated after being seen, and their merits demonstrated.

Granted Electrical Privileges.—The City Council's Electrical Committee, at its recent meeting, decided to report favorable ordinances granting permission to the Manufacturers'

Electric Company to lay and maintain underground conduits on certain streets, also to the Northern Electric Light and Power Company.

President Stevenson on the Trolley.—"The New Philadelphia will never be born," declared President Howard H. Stevenson, of the People's Railway Company, recently, "until the citizens permit the erection of overhead wires. Rapid transit is essential to a realization of their hopes for progress, and they have it in their power to secure that sorely needed improvement. The fate of the city rests in their own hands."

Favors Electric Railways.—Postmaster General Wanamaker appreciates the value of electric rapid transit, as instanced by the following extract from his recent report to Congress: "A new element in transportation is likely to furnish the means of advancing mails in rural neighborhoods adjacent to cities and large towns. I refer to the electric railway systems. They are going into suburbs not traversed by horse cars and where other means of conveyance must be slow, because of the rolling character of the country; they travel uniformly eight or ten miles per hour, and with a frequency much greater than would be required even with free delivery extensions." W. R. W.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Jan. 16, 1892.

Mr. George Cutter, of Chicago, was in town this week.

The Eastern Electric Supply Company.—Mr. J. E. Wilson will hereafter represent this company in the supply department in the New England territory.

Boston's Rapid Transit Commissioners advocate building an elevated electric road, with a tunnel under the Common, the road to be called the Metropolitan Railroad. The road will circumscribe the business district and lines will radiate to the suburbs.

The Pettingell-Andrews Company.—The sales of P. A. wire are increasing each week, and there is every reason to expect this will continue indefinitely. Business during the year just past has been very satisfactory, and the prospects for 1892 are exceedingly bright.

The Consolidated Manufacturing Company is sending out to its many customers and friends a very neat celluloid letter opener and a game counter which will be appreciated by those fortunate enough to be included in the list. Mr. C. E. Bibber reports the sale of electric fixtures as being very good.

The New England Electric Club.—The committee on selection of location of rooms reported on Wednesday last, and it is understood that a location on Bosworth street has been recommended. Another meeting will be held in a few days, at which time the matter will be definitely settled, as well as other important questions.

The West End Street Railway Company has petitioned the selectmen for locations for poles on the streets of the town now used for transportation purposes by that company. This is the first step taken toward instituting the overhead electric trolley system of motive power in Brookline to replace the horse cars. A hearing on the petition will be held Monday evening, Jan. 25.

The Stirling Boiler Company, through their agent, J. Bradford Sargeant, Boston, report the following sales of their celebrated boilers: Minneapolis Street Railway Company, 2,000 h. p., second order; city of Toledo (water works), 1,500-h. p. It should be noted that this latter order was secured in competition with some twenty different manufacturers including every type made in this country.

The Rapid Transit Commission of the State of Massachusetts and the city of Boston is distributing the printed reports of Hon. John E. Fitzgerald and Hon. Osborne Howes, Jr., on the "Transportation of Passengers in and Around the Cities of Europe." We are indebted to Mr. George S. Rice, Chief Engineer of the Rapid Transit Commission, for copies of each. They are very complete and are the result of personal visits made by Messrs. Fitzgerald and Howes to European cities in the interest of the commission of which they are representative members. They evidence careful investigation and consideration of the object of their visit abroad and are worthy the perusal of any who may have to deal with the question of rapid transit. C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Jan. 16, 1892.

The Chicago Battery and Traction Company, an electric concern, has made an assignment to George E. Farley. The assets are placed at $2,000 with liabilities of $1,630.46. The company had offices in the Rookery.

Mr. A. H. Bauer, chief electrician of the Pullman company, has been in Wilmington, Del., during the last week, equipping the Florida Special and other vestibule trains with the Bauer system of electric lighting from accumulators.

The Thomson-Houston Electric Company, through its Western agent, has arranged, it is stated, to make a magnificent electrical exhibit at the World's Fair. A united exhibit of the various Thomson-Houston companies is planned, and probably $500,000 will be spent on the exhibit.

Mr. F. P. Mack, Western manager of the Underwood Manufacturing Company, of Tolland, Conn., has sold to the Chicago Arc Light and Power Company, since Jan. 2, 40 Underwood cotton-leather dynamo belts of the following sizes: One 15-inch belt 39 1/2 feet long, three 14-inch belts 175 1/2 feet long, five 13-inch belts 245 1/2 feet long, one 12-inch belt 68 1/2 feet long, seventeen 10-inch belts 835 1/2 feet long, three 9-inch belts 135 1/2 feet long, seven 8-inch belts 368 1/2 feet long, two 5-inch belts 26 1/2 feet long, one 4-inch belt 16 1/2 feet long.

The Electricity Building of the World's Fair is progressing. The framework has been completed above the gallery floor and the majority of the steel trusses for the roof are in place. Plans adopted for lighting the buildings and grounds provide for 138,218 electric lamps, of which 6,766 are to be arc lamps of 2,000-c. p. each, and 131,452 incandescent, 16-c. p. each. The electric lighting will cost something like $1,500,000. The light and motive plant at the Exposition, it is estimated, will require 26,000-h. p., of which 22,000 will be required for the electric plant.

The Chicago Electric Club will hold its next literary meeting Jan. 18, at which the following questions will be argued: Electric power transmission; alternating or multiphase vs. direct current. Mr. William Stanley, Jr., will present an argument in support of alternating currents, and Mr. Alexander Dow of the direct current. Prof. F. B. Badt will act as referee, and will sum up the arguments and give his opinion in regard to which has been supported by the strongest arguments. A general paper on electric power transmission will be presented by Mr. D. C. Jackson, C. E. F. DE L.

SOUTHERN NOTES.

WASHINGTON, D. C., Jan. 16, 1892.

Annual Meeting.—The annual meeting of the stockholders of the Hanson Battery Light and Power Company, for the election of directors, will be held at the company's office in Washington City, Jan. 19, at 3 P. M.

The Glen Echo Electric Railroad, that extends across the country to the junction of the Tenallytown Electric Road, is to be put in first class condition, to afford the Chatauqua of 1892 better accommodations, and better facilities than it had last year.

United States Consul George F. Hollis, at Cape Town, informs the State Department that electric lighting will probably soon be inaugurated in that quarter, and it is possible that water from the mountains will be utilized to produce the power needed.

An Electric Road to Branchville.—A meeting of citizens was held a few days ago at College Park, Md., to discuss the feasibility of constructing an electric railroad from Washington city to Branchville. The committee, composed of Dr. Wiley, J. A. Johnson, J. A. Blundon, Dr. Bliss, W. A. Bartlett and J. H. Ralston, was appointed to ascertain the cost of such a road and make other desirable investigations.

A New Railway Company.—A bill has been introduced into the United States Senate incorporating the Washington Northeastern Street Railway Company. Electric power will probably be used. The capital stock of the company is not to exceed $200,000, to be divided into shares of $50 each. The incorporators are C. P. Davis, Wm. F. Mattingly, Isaac P. Childs, Albert Gleason, Theodore R. Holbrook, L. C. Loomis and Ira J. Baker. The road is to run along the streets in the northeastern part of the city and will probably be extended to Ivy City and Brookland.

The Original Recording Receiver, invented by Albert Vail, and used upon the first telegraph line ever constructed—that between Washington and Baltimore—upon which was received the historic message "What hath God wrought," is now in the possession of Stephen Vail, of New York City, son of the inventor. It is thought by Senator McPherson that its possession by the government would be most gratifying to the National Museum, where it is now a loan, and he has introduced a bill authorizing its purchase at a cost of not more than $10,000, upon the production of such evidence of its authenticity as shall be satisfactory to the secretary of the Smithsonian Institutiod. F. A. O.

NORFOLK, Va., Jan. 16, 1892.

Wilmington, N. C.—An isolated electric light plant has been put into the Wilmington Cotton Mills.

Portsmouth, Va.—The Portsmouth Electric Company has been granted a charter by the Legislature of Virginia.

Dallas, Tex.—An electric light plant will probably be put into the building of the Texas Furniture and Storage Company.

Athens, Ga.—The growth of the city demands more lights, and the Council will at once proceed to negotiate for electric lights.

Suffolk, Va.—Charter has been granted to a company of which J. W. H. Porter is an incorporator, to run a first class electric railway.

Houston, Tex.—A contract has been let by the city for the installation of an electric fire alarm system of 50 boxes and 20 miles of wire.

Savannah, Ga.—The adoption of electricity as a motive power is now being considered by the Savannah and Isle of Hope Railway Company.

Lovingston, Va.—Endeavors are being made to organize a company to run a telephone from Lovingston to Montreal, the nearest telegraph office.

Elizabeth City, N. C.—An electric light plant is in contemplation by the Improvement company. E. F. Aydutt, president, can give information.

Macon, Ga.—The survey for the Macon & Indian Springs Electrical Railroad Company's road has commenced. The president of the road is T. J. Carling.

Tampa, Fla.—An electrical railroad will be built by a Northern company, just organized, from Tampa to Tarpon Springs, Anclote, Sutherland, Dunnedin and Clearwater.

Buena Vista, Va.—At a recent meeting Superintendent Guthrie was authorized to contract with the Norfolk & Western company for 84 incandescent lights for the new depot.

Chattanooga, Tenn.—Mr. C. T. Raymond, for several years manager of the Western Union Telegraph Company in this city, has accepted the managership of the Postal Telegraph Company's office.

De Land, Fla.—The De Land Manufacturing Company has let contracts to the Thomson-Houston Electric Company for the erection of an electric light plant for its foundry and machine shops.

Richmond, Va.—Mr. Mushback has presented in the Virginia Legislature a joint resolution to permit the Compagnie Francaise du Télégraphe de Paris à New York to land its cables on the Virginia coast.

Macon, Ga.—Receiver Winters, of the Macon Street Electric Railway, has petitioned the Superior Court that he be allowed to either sell the road or issue receiver's certificates with which to improve and extend the line and erect a power station.

Roanoke, Va.—The work of constructing the telegraph line along the Roanoke and Southern Railroad will soon be pushed to completion. The Western Union already operates the line from Winston, N. C., to Martinsville, Va., and poles are now being distributed to Roanoke.

Port Norfolk, Va.—An electric railroad company has been organized. The following were elected officers: S. M. Cooper, of Cincinnati, president; Col. W. H. Stewart, vice-president, and H. B. Mason, of Norfolk, secretary and general manager. Directors: S. M. Cooper, W. H. Stewart, H. B. Hobson, and R. Carpenter, of Mansfield, O. A resolution was passed instructing the general manager to procure estimates for the construction of the road and the purchase of its equipments. V. N. B.

CANADIAN NOTES.

OTTAWA, Jan. 14, 1892.

East Angus, N. W. T.—The Royal Electric Light Company is rapidly extending its system in this town.

Kingston.—B. W. Folger states that if an electric street railway would not cost more than $75,000 he will have one in the city next year.

Kamloops, B. C.—The Kamloops Electric Light Company has taken over the electric lighting plant from Mrs. A. L. Saycier, and C. D. Grant has been appointed business manager of the company.

Oakville, Ont.—The Ball Electric Light Company is getting the poles ready, and otherwise preparing for the introduction of its system of lighting the town, according to the agreement entered into with the City Council some weeks ago.

Chatham, N. B.—Letters patent have been granted to Messrs. J. B. Snowball, James D. B. F. MacKenzie, W. B. Snowball and Geo. E. Fisher, of Chatham, incorporating the Chatham Electric Light Company, with a capital of $20,000, divided into 200 shares of $100 each.

Montreal.—Already Vancouver, Winnipeg, Windsor, St. Catharines, Toronto and Ottawa have electric street car systems in operation, and the St. John and Port Arthur lines are under construction, while Montreal lags in the rear with its antediluvian horse car system.

Peterboro.—The Town Council has passed a by-law granting the franchise of the streets of Peterboro for 20 years for an electric street railway to the Edison syndicate, composed of John Kreusi, H. M. Francis, John Langton and M. D. Barr. At the same time a contract has been closed with the Peterboro Light and Power Company for 75 all-night electric lights at 25 cents per light per night for the year.

British Columbia.—Application has been made to the Provincial legislature to incorporate electric lighting companies, to construct and maintain works, and use so much of the waters of the Capilano River and Lynn River, Burrard Inlet, and of the Coquitlam River, both in New Westminster district, as may be necessary for the purpose of generating electricity to be used as a motive or illuminating power. Also to incorporate a company to construct and maintain electric power and light stations, and a system of electric lighting at some point on Seymour Creek, or the Capilano River in New Westminster district, with power to construct and maintain tramways on the north side of Burrard Inlet.

Stratford, Ont.—A deal has been made between the Stratford Gas Company and the Reliance Electric Light Company by which the Reliance Company agrees to surrender and transfer its contract with the city and retire from the business here for a cash consideration of $5,000 and two miles of wire, poles and lamps, the remaining 15 or 16 miles of wire, poles and lamps and dynamos to remain the property of the Reliance Company and be removed from the city. The Gas Company assumes the city contract on the terms specified therein, relieves the Reliance Company of its contract for power with the North American Mill Building Company, and withdraws the legal proceedings entered to set aside the contract. F. L. J.

News of the Week.

THE TELEPHONE.

To Regulate Telephone Charges.—The City Council of Dubuque, Ia., has resolved to memorialize the State Legislature for permission to regulate telephone charges.

Erie Telephone Company's sub-companies made a net gain of 88 subscribers in December, making 278 for the quarter ending Dec. 31 and 863 for the year 1891. The total number connected Dec. 31 was 14,011.

Kingston, Pa.—The local telephone company and the Wilkesbarre and Wyoming Valley Traction Company are having considerable trouble, the former claiming that the highly charged wires of the latter seriously interfere with the telephone circuits.

The Erie Telephone Company's sub-companies have under ground in Minneapolis, St. Paul and Cleveland, 2,611 miles of wire and 68 miles of cable direct, sufficient space remaining unused in the ducts to permit of drawing in 2,500 more miles of wire.

The Amagansett Telephone Company, of Amagansett, N. Y., at its recent annual meeting elected the following officers: President, B. H. Barnes; vice-president, J. M. Schellinger; secretary and treasurer, Wm. L. Cartwright; superintendent, Geo. C. Hand. The directors declared a dividend of 5 per cent.

THE ELECTRIC LIGHT.

Fletcher, Colo.—It is stated that an electric light plant will be put in in the spring.

Exeter, N. H.—An effort is being made to re-establish the Exeter Electric Light Company.

Petaluma, Cal.—Improvements are being made in the plant of the Petaluma Electric Light Company.

Calvert, Tex.—It is expected that an electric light plant will be erected, as the citizens are in favor of the project.

Lake City, Colo.—A new electric light plant is in operation and five arc lights and 285 incandescents are used.

Crawfordsville, Ind.—The Crawfordsville City Council has decided to borrow $20,000 with which to enlarge its electric light plant.

Reynoldton, Pa.—The borough is negotiating with the McKeesport Light Company to supply the borough with electric lights.

Hokah, Minn.—The large flouring mill owned by Cargill Bros. is to lighted by 50 electric lights. The machinery is being installed.

Rock Hill, S. C.—The Rock Hill Electric Light Company has increased the capacity of its plant by adding a new 100-h. p. engine and a new dynamo of 1,000 light capacity.

Wichita Falls, Tex.—The City Council has granted franchises for three years to the Wichita Falls Light and Power Company for lighting the streets of the city with arc lights.

Alton, Ill.—The Upper Alton village board has decided to submit the matter of electric lights to a vote of the people. It is thought that the project will be carried by a good majority.

The Consolidated Electric Light and Power Company, of Kansas City, Mo., contemplates several important additions to its plant and will make a reduction in the price of light.

Stillwater, Minn.—The Stillwater Electric Railway Company has been refused the right to furnish electric light and power, the City Council claiming it is not operating its lines according to ordinance.

Charleston, S. C.—It is reported that the improvements which are being made to the plant of the Charleston Light and Power Company will be completed by Feb. 1. The capacity of the plant is being doubled.

Dubuque, Ia.—The city electric lighting contract has been let to the Edison company. The bid was for 200 lamps for $64 each on moonless and cloudy nights, $100 for every night. The contract is for three years.

St. Charles, Mo.—A special election will be held in February for the purpose of voting a bonded indebtedness on the city to enable it to own and operate an incandesent electric light plant in connection with the present arc light system.

For an Edison Plant.—Negotiations for forming a company to establish an Edison electric light plant in Baltimore, Md., are

still pending, it is stated, with little prospect of success. If formed, the wires will all be placed under ground.

The Bartlett Illuminating Company, of Saginaw, Mich., has recently installed a new 1,400-light Thomson-Houston alternator and a 50-light Thomson-Houston arc machine in its plant, and started a new 600-h. p. compound Corliss engine.

Baltimore, Md.—The engineers of the Belt Line tunnel, now being constructed under Baltimore, to connect the Philadelphia division of the Baltimore & Ohio with its Washington branch and main line, propose to light it by electricity.

Fresno, Cal.—The Edison Electric Company has started up its new plant, which was recently installed by the Edison company. It has a capacity of 3,500 incandescent and 50 arc lights. J. D. Cunningham is superintendent of the company.

Cost of Electric Lighting.—The committee chosen to consider the advisability of establishing a town electric light plant, at Marblehead, Mass., has reported in favor of the project. It places the cost of the plant at about $40,000, and the cost of operating about $8,025, or $4,000 more than the present cost of lighting.

The Lufkin Rule Company, of Saginaw, Mich., is putting in one of the most complete isolated plants in the State. It consists of two dynamos, one 90-light and one 200-light Edison machine. Current is also used for running some special machinery. The plant is being installed by the Bartlett Illuminating Company.

Richmond, Va.—The electric lighting committee of the City Council at its recent meeting opened bids for the electric lighting of the city for four years, and the contract was awarded to the Richmond Railway and Electric Company for 500 lights of 2,000 c. p. at 27 cents per light per night. It is expected that the plant will be in operation within four months.

Newark, Ohio.—At a recent meeting of the City Council the Committee on an Electric Light Plant reported, and it was resolved that the city solicitor, the civil engineer and J. M. Maylone be appointed to report to the Council the name of a competent, disinterested electrical engineer and at what price he will examine, correct, amend and approve the plans, estimates and specifications for an electric light plant, and make such recommendations in the premises as he deems proper.

Mobile, Ala.—The electric light committee of the General Council at a recent meeting opened the bids received for furnishing an electric light plant and for lighting the city. A large number of bids were received, and the committee decided to recommend for adoption the bid of the Economical Electric Light Company, of New York, whose bid was $86 per light per year, moon schedule. The proposal requires the erection of a permanent plant. The city has been paying $91 per light, moon schedule.

THE ELECTRIC RAILWAY.

Shelbyville, Ind.—An electric railway is in contemplation.

The Park Hill Motor Line, of Denver, Colo., it is stated, will be changed to an electric road within a short time.

Cumminsville, O.—Several capitalists are contemplating building an electric road between this place and Clifton.

Belleville, Ill.—J. H. Atterbury, of Litchfield, Ill., is trying to get a franchise to construct an electric railway at Belleville.

Los Angeles, Cal.—The cable road, it is stated, contemplates changing its horse car lines to electrical, and will thereby effect a saving, it is claimed, of $50,000 a year.

Olympia, Wash.—Four miles of electric railway within the city, with extensions to Tumwater, will be built by the Olympia Light and Power Company, which has secured a loan of $250,000 for the purpose.

Nashville, Tenn.—It is reported on good authority that Mr. Fred. W. Hunter has secured an option on the Overland Railway and that within a short time it will be converted into an electric line.

The Haywards Electric Railroad Company, of Oakland, Cal., has commenced laying its track, and its power house is nearly completed. It is expected that the road will be operated by April 1.

A new electric railway is projected by Robert Tobin and others, of San Francisco, Cal., to run from Colma to San Pedro, connecting with the San Francisco & San Mateo electric road. The expense of construction will be $12,000 a mile. Concessions have been asked from the San Mateo Board of Supervisors.

Chicago, Ill.—J. M. MacDonald, of Youngstown, O., and several other capitalists, have organized a company, with a capital stock of $2,000,000, to erect what is known as the Day system of elevated electric railroads in Chicago. Franchises have already been received, and one of the lines constructed will be two miles long.

The Metropolitan Electric Railway, of San Francisco, Cal., it is stated, may be pushed to completion, a syndicate composed of P. N. Lilienthal, E. L. G. Steele, J. H. Smith, J. C. Cebrian, F. P. Hooper, J. A. Hooper, H. Dintard, C. A. Fletcher, W. Easton, Geo. W. Frink and others having recently purchased C. E. Mayne's interest in the same.

The St. Louis (Mo.) & Kirkwood Rapid Transit Company, which contemplates changing its equipment to an electrical system, is meeting with considerable opposition from property holders along the route. The matter has been brought before the county court for adjudication, which it is thought will be favorable to the road.

Trolley System Approved.—The State Board of Railroad Commissioners on Jan. 13 approved a change of motive power by the Brooklyn City and Newtown Railroad Company from horse to an overhead single trolley electric system. The Brooklyn City Council by a vote of 15 to 4 passed a resolution over the Mayor's veto, granting the street railway companies the same right.

The Central Railroad, of San Francisco, Cal., commonly known as the Turk street line, is considering the proposition of equipping its lines electrically. It is stated that the Metropolitan Railway Company will have its lines running by electricity by April 1. Capitalists have been more favorably disposed toward electric traction during the past few months and the results are telling.

The Broad Ripple Rapid Transit Company, of Indianapolis, Ind., has sent a communication to the Board of Public Works requesting an extension of time for the completion of its lines until Sept. 1, 1892. The board claims the road has no franchise with the city, having forfeited the same. The company claims to have been hindered in completing its lines by its suit with the Edison company.

The Fresno Electric Railway Company, of Fresno, Cal., recently incorporated, with a capital stock of $1,000,000, has organized and elected officers as follows: Marcus Pollasky, president; J. R. White, treasurer, and Maurice Messinger, secretary. The new company has bought the three lines of street railway of the city and will at once construct 12 miles of electric road. It is reported that the road will soon be extended through the colonies to Handford, a distance of 30 miles.

The Brooklyn City Railroad Company contemplates operating cars from the city line to Fort Hamilton by electricity. For this purpose an extension will be made to the electric power station at Fort Hamilton. The annual election of the officers of the company occurred Jan. 12. There were no changes further than the selection of Secretary Thompson as treasurer, who will also retain the position of secretary, and the election of Crowell Hadden as auditor. The other officers were all re-elected.

Complete Rapid Transit.—The city of Pueblo, Colo., it is stated by the Denver *Republican* in its annual review of the year 1891, has one of the most complete electric systems in the United States. Twenty-two miles of road are operated; capital invested, $640,000. During 1891, $75,000 were spent in improvements. Extensions are contemplated. Colorado Springs also has a first-class electrical system of 25 miles. The capacity of its power plant has been doubled since the road was started 18 months ago.

The Bristol (Tenn.) Belt Line Railway, which was equipped throughout by the Short Electric Railway Company, and had been in operation about one week, lost nearly $20,000 by the recent fire. One dynamo and four Brill cars and trucks, with complete electrical equipment, were consumed. An order has already been placed with the Short Company for additional equipment, and a few cars will be in operation in a very short time. Fortunately for the Bristol people, their private car, which is to run between the railway station and the hotels, had not yet reached Bristol.

The Atlanta (Ga.) & Chattahoochee electric railway is under contract for an elaborate electrical equipment, to be in operation by the 15th of February, and by that time it is expected that fifteen miles of track will be completed. The electrical equipment is of the latest pattern, and embraces improved appliances not heretofore used in Atlanta. The contracting firm is the Short Electric Railway Company, of Cleveland, O. The projectors of the line are Mr. C. J. Simmons and Dr. Baker, who built the road, not with Northern capital, but with their own resources and the assistance secured along the line.

LEGAL NOTES.

In the case of the Brush Electric Light Company vs. the City of Cincinnati, O., for the recovery of a $50,000 deposit made in connection with its bid for electric lighting, Judge Hunt has sent the same to the General Term. The city resists the claim on the grounds that a great loss has been sustained by the failure of the Brush company to do the city lighting at the figure named in its bid, the loss reaching $80,000 per year, or for the term of the contract, 10 years, $800,000.

Dissolved the Injunction.—Judge Barrett in the Supreme Court has dissolved the injunction which he granted in the injunction suit brought by Mr. Martin A. Frank to restrain the Edison Electric Light Company from declaring a dividend, on the point which was made that if Frank was dissatisfied with the determination to declare a dividend he should bring a separate suit for that purpose, instead of applying in the old suit. On its merits the judge was inclined to think the injunction should stand.

Arguing for a Patent.—In the United States Circuit Court at Trenton, N. J., the case of the Brush Electric Company vs. the Accumulator Company came up for hearing before Judge Green on Jan. 7, on an application for a preliminary injunction to restrain the defendants from infringing on the patents of the complainants on storage batteries. William C. Witter made a long argument for the complainants, and was followed by Fred. H. Betz for the defendants. Mr. Betz had not concluded at the hour of adjournment. The case was postponed until Jan. 19.

Suit has been entered by the German Savings and Loan Society against the Central Electric Railway Company and the Sacramento Railway and Improvement Company, of Sacramento, Cal., which sets forth that plaintiff is the owner of $500,000 bonds issued by the Improvement Company secured by mortgage, etc. and that by conveyance on the part of the Improvement Company to the Electric Railway Company certain franchises were turned over which the Electric Railway Company now contemplates abandoning. Plaintiff prays that the action of the Electric Railway Company be declared void.

An Action based on stock transactions has been begun by Edward S. Stokes before Judge Ingram in the New York Supreme Court, against John W. Mackay and Hector de Castro, to recover $75,000 on stock transactions based on the delivery of stock, bonds and contracts of the United Lines Telegraph Company, the Chicago Board of Trade Telegraph, Pacific Telegraph Company, Pacific Mutual Telegraph Company and Lehigh Valley Telegraph Company. The contract was made on Dec. 26, 1888, by which for a consideration of $100,000 Stokes was to deliver the above stocks, etc. He claims to have received Feb. 25, 1889, $25,000, on account and sues to recover the balance.

PERSONALS.

Mr. C. K. Minary, formerly manager of the Rochester (N. Y.) Electric Railway Company, has resigned and will engage in business at his former home in Louisville, Ky.

Mr. E. L. Dolby has retired from the editorship of *Electrical Plant* and will devote his entire attention hereafter to his practice of consulting engineer at 8 Prince's street, Westminster, S. W., England.

Mr. Frank B. Rae, it is stated, is not actively connected with the Detroit Electrical Works at the present time, his patents on electric railway and other work having been assigned to the company

Changes in the Staff of "Electricity."—The two editors, Mr. Herbert Laws Webb and Geo. H. Guy, as well as Mr. Paine, of the business department of our contemporary, *Electricity*, have resigned their respective positions.

Mr. W. H. Harding, formerly associated with the Fort Wayne Electric Company and also with the Southern Electric Company, of Baltimore, Md., is to take charge of the plant of the Louisiana Electric Light Company at New Orleans.

Mr. A. P. Seymour, formerly superintendent of the Syracuse Electric Light and Power Company, has resigned in order to embark in other business: At the recent meeting of the board of trustees of the company resolutions expressing regret at his resignation were unanimously adopted.

Mr. M. J. Sullivan has taken up his new work as editor of the *Street Railway Gazette*, of Chicago. This journal began the publication of a weekly edition on the first of the year, and the first number under the new arrangement shows that it is to be largely a street railway *newspaper*. Mr. Sullivan's many New York friends look for good results from his vigorous work.

Mr. Thomas M. Jenkins, formerly superintendent of the Albany Railway, and for the past year superintendent of the South Covington & Cincinnati Street Railway, has been elected general manager of the South Covington & Cincinnati, the Dayton & Newport, and the Newport & Cincinnati Electric Street Railway companies.

The marriage of Miss Frances Elizabeth Olmstead, of Geneseo, N. Y., to Mr. Frederick Vance Doty, of Buffalo, took place on Thursday evening, Jan. 14, in the Presbyterian church at Geneseo. A reception was afterward given at the home of the bride. Mr. and Mrs. Doty will be at home after Feb. 22 at the Tifft, Buffalo, N. Y. Mr. Doty is the popular manager of the Aluminium Carbon Company.

MISCELLANEOUS NOTES.

To Place the Wires Under Ground.—An effort is being made by the city of Baltimore, Md., to secure the necessary legislation to have its telegraph wires placed under ground.

Dubuque, Ia.—The Edison Electric Light Company will furnish the town with 200 electric lights during the next three years at $64 per lamp per year, underbidding the old company $11 per lamp.

The California Electric Light Company, of San Francisco, Cal., has contracted, it is stated, with the Edison General Electric Company for the changing of its system to underground conduits, at a contract price of $50,000.

The largest electric hoist ever constructed, it is stated, is being fitted up in Factory L at the Thomson-Houston Works in Lynn, Mass., for Neohart & Meyer, of the Queen of the Hills Mine, Montana. The rope will be 1,600 feet long.

Electric Switch Engines.—The Philadelphia & Reading Railroad has ordered two electric switch engines built by the Thomson-Houston company. Overhead wires will be strung through the company's yards, and the engines will be used for switching purposes exclusively.

Overhead electric light wires in San Francisco are to be removed by order of Judge Hebbard, who has rendered a decision affirming the validity of the municipal ordinance calling for the removal from the roofs of buildings of all wires used to conduct electricity for lighting or motive purposes.

The Edison Electric Illuminating Company's new plant at Atlanta, Ga., it is stated, is being pushed to completion. It will be under the same management as the Georgia Electric Light Company, of which H. M. Atkinson is president, and will do all incandescent lighting for both companies.

The power to be used in the new buildings which are being put up by the Blatz Brewing Company, at Milwaukee, Wis., will be electricity. There will be two generators, one of 250 h. p. and one 100 h. p., and 23 motors to distribute the power. The apparatus will be furnished by the Mather Electric Company, of Manchester, Conn., and it is expected that a portion of the plant will be operating by March 1, and the whole completed by May 1.

An electric apparatus for transmitting orders from the bridge to the engine room of an ocean steamer has been accepted by the United States Navy. It is the invention of D. D. Watt, of San Francisco. It consists of a device by which signals from the bridge are transmitted to the engine room and indicated on a dial and are repeated back to the bridge by the engineer. This is accomplished by means of a lever which insures the correct transmission and understanding of the order.

Wants the Thomson-Houston Plant.—Mention was made in a recent issue of THE ELECTRICAL WORLD of the fact that the Thomson-Houston Electric Company was considering the advisability of putting up a plant in the West and had been looking over several manufacturing sites near Pullman, Ill. St. Louis is making an effort to have the company locate in that city or near it, and at a meeting of the Merchants' Exchange recently Mr. James Campbell was authorized to telegraph President Coffin, of the Thomson-Houston Company, as follows: "C. A. Coffin, No. 20 Altantic street, Boston, Mass.: Would a donation to your company of several acres of ground be any inducement to locate your works here? James Campbell." The reply to which was the following: "Thanks for proposition. Will wire." It is stated that St. Louis has decided to have the works if possible and will offer inducements which will win.

Industrial and Trade Notes.

The Hill Clutch Works, of Cleveland, O., has secured the contract for a number of Hill clutch pulleys from the Cincinnati Electric Light Company.

The Laidlaw & Dunn Company, of Cincinnati, O., dealers in pumps, machinery and supplies, has been awarded the contract for two compound pumping engines, boilers, etc., for the North Baltimore (O.) city water-works.

J. Lang & Co., of 44 Michigan street, Chicago, Ill., manufacturers of steam and electrical specialties, have issued a supplementary catalogue of the various specialties manufactured by the company. It is illustrated and gives a price list of all the various articles.

The Hess Electrical Company, of 720 Walnut street, Des Moines, Ia., has recently issued an illustrated catalogue and price list of general electrical supplies. It covers 117 pages and is very complete, giving a large list of electric specialties manufactured and handled by the firm.

The graphite productions of the Jos. Dixon Crucible Company, of Jersey City, N. J., are illustrated in a 40-page catalogue and price list which the company is now sending out for 1892. This company is the oldest in the graphite trade, and the only manufacturer possessing graphite mines of its own.

The Southern Electric Company, of Baltimore, Md., J. Frank Morrison, president, is furnishing the two cruisers Detroit and Montgomery with all electric appliances. The contract is for $6,000, or $3,000 for each vessel. Some of the apparatus, it is stated, are recent inventions of the company.

Cylinder Oils.—After thoroughly testing the leading cylinder oils, a prominent electrical company has contracted with the well known house of George P. Jones & Co., of St. Louis, for a year's supply of their Peerless cylinder and dynamo oils. A sample of the oils selected will be sent free to any power station.

The Novelty Electric Company, of 50 North Fourth street, Philadelphia, is placing on the market an electric wire gauge which is very simple and convenient for finding the desired size of wire required to carry a given number of lamps and the number of lamps a wire will carry. This company manufactures an extensive line of electrical goods and reports meeting with the best of success in its business.

The Ashton Valve Company, of 271 Franklin street, Boston, and 107 Liberty street, New York City, has sent us one of the prettiest calendars for 1892 that it has been our fortune to see. The steel plate has for its subject "The Dawn of the New Year," and is admirably executed. We are glad to see the enterprise of the Ashton Valve Company in this line, and if other companies are inspired to emulate its example our offices will present the appearance of an art gallery by this time in 1893.

The Engineering Equipment Company, of 143 Liberty

street, New York, reports that it is shipping large quantities of Underwood cotton leather belting, and that it is giving the best of satisfaction. The Edison central stations of New York and Brooklyn; the Edison Company, of Paterson, N. J.; the Buffalo, N. Y., street railway power house; the Rochester Electric Light Company, and the People's Electric Light Company, of Oswego, N. Y., are all equipped with these belts, all of which, it is stated, are giving the best of service.

Wagner-Queen Voltmeter.—A few weeks ago we described the new portable voltmeter which bears this name, and which has been placed on the market by Queen & Co., of Philadelphia. The prominent features of this instrument are such that it would seem to be of great value to electricians for measuring both alternating and direct currents. It is very portable, weighing only 22 ounces, and the dimension of the case are 7¼ × 4 × 2 inches, so that it can be carried in a good sized pocket. The pointer is dead beat, and the instrument is direct reading. It is claimed that the indications are accurate within one per cent. They are being offered at a very reasonable price, easily within the reach of all. We are informed by the makers that, up to date, the demand has far exceeded the supply of these voltmeters. A large quantity is being pushed through their factory, and they hope soon to keep up with the orders as received, so that delays in shipment will not occur. Those in need of a good portable voltmeter for both alternating and direct currents can obtain a copy of circular No. 265 from Queen & Co. which fully describes the Wagner-Queen instrument.

The Detroit Electrical Works, of Detroit, Mich., recently received the following letter from the Athens Railway Company, of Athens, Ga.: "Regarding the Detroit Electrical Works' standard electric railway system, which you furnished the Equitable Engineering and Construction Company, of Philadelphia, for our line here, consisting of four 30-h. p. motors and one 80,000-watt dynamo, would say that we are well pleased with the equipments, and we are also satisfied that we are operating our motors 50 per cent. cheaper than any other system now in use. We have had very little trouble or expense with the bevel gear; in fact, there is no trouble with it when the friction collars are kept well adjusted, which is very simply and easily done And as to the dynamo, it has not caused us one minute's delay or one cent of expense. I claim that we have got the best equipped road anywhere, to my knowledge. Our cars make less noise and run smoother than those of any other system that I have ever inspected. I have been in the street railway business for some 12 years, and last year, before we began to make any change in our line here, I made a tour of inspection of the different systems. The single motor geared direct to each axle cannot be beaten anywhere, and that is just what we have. We would be glad at any time to show any one our system here. Yours respectfully, J. T. Voss, General Manager.

The Elektron Manufacturing Company, of Springfield, Mass., has recently installed a large number of plants for power purposes to replace steam in printing establishments. Until recently it has been thought absolutely necessary to have a steam boiler in a newspaper establishment for the purpose of furnishing the steam heat to dry matrices in the stereotyping department, and for this reason many publishers held on to their steam power although satisfied that electric power would be cheaper and more satisfactory. The following letter was recently received from Messrs. Warfel & Geist, of Lancaster, Pa., whose power plant was the first installed by the Elektron Manufacturing Company for printing purposes: "One year ago we substituted electrical for steam power in the New Era Printing House. A 20-h. p. Perret motor furnishes power for the machinery in the main press room, driving a Goss perfecting newspaper press, with double folder, an Adams and three cylinder book presses, freight elevator, and the machinery in stereotype foundry. A 10-h. p. Perret motor furnishes power for the half dozen presses and other machinery in the jobbing department, with ample reserve power for increase of both plants. The performance of these motors has been very satisfactory in all respects. They run free from sparking, maintain a uniform speed under all variations of load and cost nothing for engineering. We would not exchange for steam power upon any consideration. They are always ready for duty at any hour of the day or night without waiting to 'get up steam.' Steam for drying matrices is furnished by Murray's generator and steam table combined, which is both economical and convenient. As you are aware, we selected the Perret motor from a number of competitors, because, while equal to the best in points in common, it was the only one which developed its maximum power at such slow speed as enabled us to run our line shafts without the intervention of counter shafting. The experience of a year fully confirms our judgment in the selection of these machines."

Business Notices.

Complete Equipment of electric light and power plants with the Mather system. Also agent for the Perkins incandescent lamp. E. T. Pardee, 14 Butler block, Syracuse, N. Y.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JAN. 12, 1892.

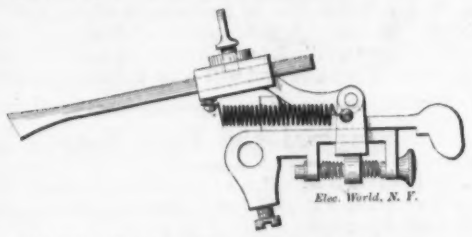
466,781. Electric Steam Engine Governor; Frank M. Garland, of New Haven, Conn. Application filed Feb. 26, 1891. A steam engine governor consisting of a valve having a spindle bearing a worm gear, an oscillating worm meshing with the gear, and a continuouly revolving disc adjacent to the worm, whereby the worm is rotated in opposite directions, according to its position of oscillation.

466,784. Electrical Annunciator; William F. Harte, of Omaha, Neb., Assignor to the Automatic Call Manufacuring Company, of same place. Application filed July 25, 1891. In an electrical annunciator the combination with a case of wires, a battery and a call bell forming part of the circuit, contact posts, driven hand having a wheel for consecutively engaging the posts, an arm for detachably engaging the posts and a ratchet.

466,787. Electric Indicator; Charles W. Holtzer and George E. Cabot, of Brookline, Mass., Assignors to the Holtzer-Cabot Electric Company, of Boston, Mass. Application filed April 6, 1891. An electric indicator, consisting of the combination of a rotary insulating plate adjustable angularly to any position within predetermined limits, a solenoid mounted upon said plate eccentrically, a pivotally suspended core for the solenoid suspended from projections on said plate, a beam or rod carried by said core and provided with electric contacts located between electric contacts projecting from said plate, and means for adjusting the rotary plate angularly, the axes of the core and solenoid being normally at an acute angle to a horizontal line.

466,798. Electric Battery; John S. Nowotny, of Cincinnati, O., Assignor of one-fourth to William H. Robinson, of Covington, Ky. Application filed March 23, 1891. A carbon battery having radially projecting walls extending from the outer wall toward a common centre, the sides of the walls corrugated, the walls and bottom being of carbon.

466,800. Wire Support for Electric Railways; William Q. Prewitt, of Lexington, Ky. Application filed March 26, 1891. In a trolley track hanger, two members provided with laterally extended securing flanges jointly engaged with each other, said members constructed with clamping jaws and channeled to receive the conductor between said jaws.



No. 466,972.—Brush Holder for Commutators for Dynamo-Electric Machines.

466,802. Electric Switch; Edwin Wilbur Rice, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Feb. 13, 1891. The combination, in a circuit making and breaking switch, of a circular track having a series of double inclines, contact-plates in alternate depressions, a cross-arm, a spindle for moving the same, and a spring connecting the spindle and arm.

466,807. Electric Trolley; Elmer A. Sperry, of Chicago, Ill. Application filed June 24, 1891. In an electric trolley, an upright flexing coiled erecting spring and a trolley supported thereby with a swivel joint connection between the trolley and the spring combined with a connection of the trolley independent of the spring for preventing or controlling the rotation of the trolley with reference to the spring.

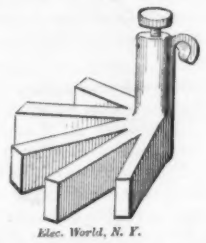
466,820. Battery Zinc and Method of Making the Same; John Beattie, Jr., of Fall River, Mass. Application filed March 30, 1891. The process of making the zinc element of galvanic batteries, consisting in subjecting divided zinc and free mercury to the action of a solution of sulphuric acid and water until partial amalgamation takes place, then drawing off the liquid and heating the metal until it melts, then adding thereto a quantity of magnesium, then casting into blocks or strips, then adding a number of the blocks or strips to pure molten zinc, and finally casting the same into the required form. (See illustration.)

466,825. Method of Electric Welding; Peter Gendron, of Toledo, O., Assignor to the Gendron Iron Wheel Company, of same place. Application filed June 17, 1891. A method of electric welding, consisting in shaping the abutting ends of the material to have contact at points in proportion to the mass, heating them by a current of electricity and subjecting them to end pressure.

466,832. Electric Motor Car; Elbert B. Phillips, of Cleveland, O. Application filed Jan. 6, 1891. The combination, with a car, of a motor having a rotatable armature axially placed with reference to and directly connected with a car axle and rotatable field magnets, a gripper or holder for preventing the rotation of the field magnet, so that the motor may propel the car direct, a gripper, and gearing between the axle and the field magnets adapted to be put into and out of action, so that the motor may propel the car through said gearing.

466,858. Printing Telegraph; John E. Wright, of New York, Assignor by mesne assignments to the American Type Telegraph, of New Jersey. Application filed Sept. 5, 1891. In a printing telegraph receiver, the combination of a power driven pulley or shaft, an escapement in frictional connection therewith, a magnet for determining the extent of movement of the escapement, a rotary typewheel, a cam intermediate to the typewheel and escapement, a power driven shaft and connections for moving the cam and adjusting the typewheel to positions corresponding to those of the escapement, and an electromagnet for locking or releasing the said shaft.

466,865. Automatic Electric Heat-Alarm; Morrill Scott Pierce, of Westport, Leonard H. Desisle, of Lamoine, and Orville C. Oliver, of Eden, Assignors to the Electric Heat-Alarm Company, of Bangor, Me. Application filed Dec. 15, 1890. An electric heat-alarm consisting of the combination of a hollow metallic reservoir, a quanity of mercury within said reservoir, a metallic plug partially filling said reservoir and having a small downwardly-extending tubular bore, a conductor-wire or wire spindle supported and insulated within said plug and extending to such point as that it may be reached by said mercury when expanded and rises in said tube, the whole in combination with an electric battery having one of its poles connected with said plug and the other with said insulated conductor wire or spindle, and a bell or other alarm or indicator connected with and operated by said electric battery. (See illustration.)



No. 466,820.—Battery Zinc and Method of Making the Same.

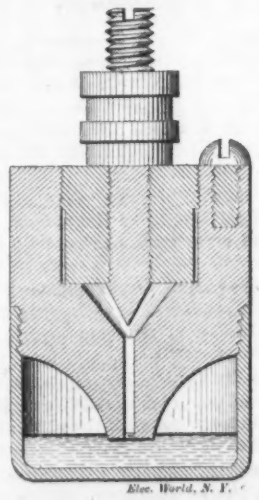
466,870. Annunciator; David Heineman, of Wabash, Ind. Application filed March 16, 1891. In combination, a drop and its controlling magnet, restoring or raising mechanism for the drops and a controlling magnet therefor, an electric alarm, a battery, a circuit closer for each drop having three contacts, and the circuits arranged so that when said contacts of a circuit closer are brought into contact the restoring mechanism will be actuated and then the particular drop will be displayed and the alarm sounded.

466,914. Railway Electric Motor; Charles F. Winkler, of Troy, N. Y. Application filed March 26, 1891. The combination with a car axle of an electric motor geared directly thereto, said motor having field-magnet coils divided into sections placed approximately at right angles to and overlapping each other. (See illustration.)

466,937. Electric Converter; Gustav Pfannkuche, of Cleveland, O., Assignor to the Brush Electric Company, of same place. Application filed Sept. 28, 1889. In a converter, a core made of two piles of blanks, each blank consisting of a long and a short arm, and coils wound around the long arms of each set of blanks.

466,953. Ammeter; Charles F. Brush, of Cleveland, O. Application filed Nov. 21, 1889. In an ammeter, the combination, with a yielding plate, of a rock shaft mounted thereon, means for limiting the movements of said rock shaft in both directions, a pointer or indicator secured to one end of said rock shaft, a double flexible conductor secured at its ends and connected at a point between its ends with said rock shaft, and means for causing one part of said conductor to have its temperature altered relatively to the other part of the conductor by the current to be measured and thereby cause a partial rotation of the rock shaft and with it a movement of the indicator or pointer to indicate the strength of the current on a scale or graduated plate.

466,972. Brush Holders for Commutators for Dynamo-Electric Machines; Isaac H. Bartholomew, of Northford, Conn. Application filed Aug. 13, 1891. In a holder for the commutator brushes of dynamo electrical machines, the combination, with a frame piece, of a brush carrier pivotally connected there-



No. 466,865.—Automatic Electric Heat-Alarm.

with, and a hand piece located between the brush carrier and the frame piece for lifting the former to retire the brush. (See illustration.)

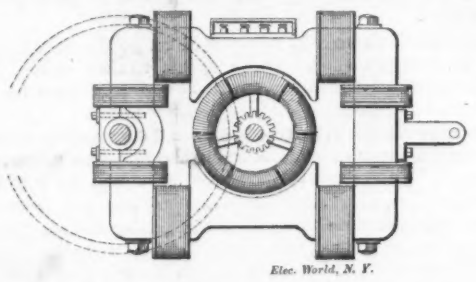
466,973. Electric Elevator; William Baxter, Jr., of Baltimore, Md., Assignor to the Baxter Electric Motor Company, of same place. Application filed Sept. 3, 1888. In an electric elevator system, the combination, with an electric motor and hoisting mechanism operated thereby and provided with a hoisting rope, of a car suspended by such rope in a hoistway, a motor circuit supplied with a current of constant potential, a switch upon the car with contacts in said circuit, and a circuit controller operating normally to open said circuit and operating with the contacts when moved to close the circuit through the motor to actuate the hoisting mechanism.

466,981. Trolley for Electric Railways; John Kuehnle, of Detroit, Mich., Assignor of three-tenths to Edward Martyn, of same place. Application filed Sept. 5, 1891. In an electric railway, the combination, with a contact arm carrying a contact device at one end and pivoted to the car at the other end, of a tension device for said arm, comprising a compression spring rod and a connection between the rod and the contact arm.

467,023. Lightning Arrester; George William Spittle, of Campos, Brazil. Application filed Sept. 3, 1891. In an automatic lightning arrester for the protection of telephonic and other electrical apparatus, the combination, with an electromagnet in circuit with the line wire and with a bracket support, of an armature pivotally mounted on said bracket support out of its centre of gravity and having its long arm arranged to be attracted by the electromagnet, a screw support arranged above the short arm of the armature, a screw engaging the screw support and having one extremity located above one side of the short arm of the armature, a screw support arranged beneath the short arm of the armature, an adjustable screw engaging the latter support and having one extremity arranged beneath the short arm of the armature, a ground wire connected with one screw, and a leading wire connected to the other screw.

467,048. Electric Motor; John H. Palmer, of Boston, Mass., Assignor of one-half to Richard Smith, of Sherbrooke, Canada. Application filed March 23, 1891. The combination, with an electric motor having its armature and field magnets free to revolve in opposite directions, of means for retarding or stopping the revolution of one part of said motor.

467,050. Electrically Controlled Car Switch; Burt I. Potter, of Boston, Mass. Application filed Jan. 13, 1890. In a track system, the combination of the following elements: a track rail, a switch point or rail adapted to be electrically controlled and operated, an electrically impelled car, an electric conductor or conductors extending along the track in the direction of travel of the car and electrically connected with the switch actuating



No. 466,914.—Railway Electric Motor.

mechanism, a contact or contacts for said conductor or conductors carried by the car, and an electric switch carried upon the car and serving to connect one or another of said conductors with the source of electricity which supplies the car motor.

467,073. Dumb Waiter Signal; Frederick Joseph Zahner, of Stanwich, Conn. Application filed Aug. 14, 1891. The combination, with an elevator shaft having doors, guides at opposite sides of said shaft, an elevator and tongues thereon, but one engaging each of said guides, of push buttons arranged on one guide, each the same distance from its door as the other, and adapted to be operated by a tongue of the elevator to close and then open its circuit, a battery, an annunciator bell, and wires leading from the battery and bell and in which the push buttons are arranged in multiple arc.

467,075. Electrical Heating Apparatus; Arthur E. Appleyard, of Boston, Assignor to H. L. Mills, trustee, of Millis, Mass. Application filed Jan. 16, 1891. In an electric heating apparatus, the combination, with a cylindrical inclosing shell or casing, of an inflexible block of homogeneous heat conducting insulating material within said shell, said block having a pocket, a rod or pencil of compressed carbon in said pocket, a plate secured to each end of the block for holding the rod in position, and electrical connections with the rod or pencil.

467,078. Rheostat; Francis O. Blackwell, of Boston, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed June 5, 1889. The combination with an electrical resistance consisting of a number of plates in contact with one another, of a controlling device adapted to move over the surface of the plates, and bring more or less of them into circuit, and a terminal piece in line with said plates, consisting of slate or other non-combustible insulation adapted to form the terminal of the series and receive the final contact.

467,085. Electric Insulator for Boilers; Peter Decker, of Norwalk, Conn. Application filed Sept. 25, 1891. An electric insulator for a steam or water pipe extending between a steam boiler and a steam engine, consisting of an insulating joint located between opposing coupling flanges on the pipe sections, a sleeve of non-conducting material on each bolt body and a washer of non-conducting material under each head and a nut on said bolts.

467,102. Nautical Signal or Sea Telephone; Ernst Huber and Frederick J. Kneuper, of New York, Assignors of one-third to James R. Davies, of same place. Application filed April 25, 1891. The combination, in an apparatus for receiving, transmitting and indicating sound, of the sound wave intercepter, the resounder, the receiver, the director, the indicator, sound wave connections between the several parts above named, an electric battery, and an electric circuit extending from the battery to and through the resounder, receiver, director, and to the indicator.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.